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Issued November 1963

SOIL SURVEY

Lehigh County Pennsylvania

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
PENNSYLVANIA STATE UNIVERSITY
College of Agriculture and Agricultural Experiment Station
and the
PENNSYLVANIA DEPARTMENT OF AGRICULTURE
State Soil Conservation Commission

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY gives basic facts about the soils of Lehigh County. These facts will increase our understanding of the land and our ability to work with nature. They will aid us in using the land efficiently, in selecting the crops that suit the soils, in deciding the kinds and amounts of fertilizer to use, in applying methods for conserving soil and water, and in using the soils for purposes other than farming.

The survey will help farmers plan the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid foresters in managing woodlands; and add to our knowledge of soil science.

Locating the soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county and the page where each is described. It also lists, for each soil and land type, the capability unit, the woodland suitability group, the irrigation group, the building site, and the pages where each of these is described.

Foresters and others interested in woodlands can refer to the section "Woodland Uses of the Soils." In that section the soils in the county are grouped according to their suitability for trees, and factors affecting the management of woodland are explained.

Sportsmen and others interested in developing areas for wildlife will find useful information in the section "Suitability of the Soils for Wildlife."

Engineers and community planners will want to refer to the section "Engineering Uses of the Soils." In that section tables show the characteristics of the soils that affect engineering, and the suitability of the soils for suburban development is discussed.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the sections "Formation and Classification of the Soils" and "Laboratory Data."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Lehigh County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

* * * *

Fieldwork for this survey was completed in 1959. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Lehigh County was made as part of the technical assistance furnished to the Lehigh County Soil Conservation District.

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SOIL SURVEY OF LEHIGH COUNTY, PENNSYLVANIA

BY JOHN B. CAREY AND MICHAEL YAWORSKI, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH PENNSYLVANIA STATE UNIVERSITY COLLEGE OF AGRICULTURE AND AGRICULTURAL EXPERIMENT STATION AND THE PENNSYLVANIA DEPARTMENT OF AGRICULTURE, STATE SOIL CONSERVATION COMMISSION

LEHIGH COUNTY is in the east-central part of Pennsylvania in the eastern part of the Kittatinny Valley (fig. 1). The Lehigh River forms part of its boundary. Allentown, the county seat, lies along the river.

Many industries are located in the county. The main industries are the manufacturing of metals and metal products, manufacturing of textiles and textile products, and processing of food and related products.

The county has a land area of 222,080 acres, or 347 square miles. About 158,000 acres is in farms, and, of this, about 123,000 acres is suitable for cultivation. Agriculture has always been a leading occupation. Many of the farms are diversified, but a number of them are dairy farms or farms where beef cattle and poultry are raised. On some farms peaches and apples are the main crops. Potatoes are a special crop on other farms.

Most of the soils are deep, and most of them are gently sloping to sloping and are silty or loamy. The soils are generally acid. Crops grown on them respond well when lime and fertilizer are added.

In some areas, particularly in the north-central part of the county, are soils well suited to peaches, apples, and potatoes, which are grown there.

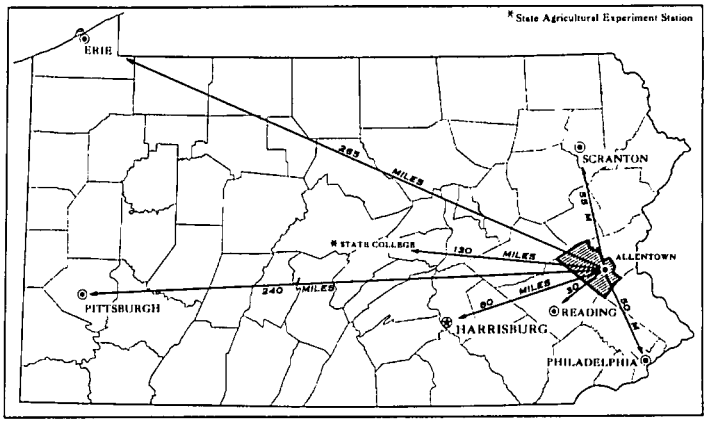

Figure 1.—Location of Lehigh County in Pennsylvania.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Lehigh County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in other counties. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in classifying local soils.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Chester and Readington, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for the texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. For example, Murrill gravelly loam is a soil type in the Murrill series.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Comly silt loam, 0 to 3 percent slopes, is one of several phases of Comly silt loam, a soil type that ranges from nearly level to moderately sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because photos show woodlands, buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The soil map in the

back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where the differences between the soils are too small to justify separate recognition for the objectives of the soil survey. Therefore, he shows the soils as one mapping unit and calls it an undifferentiated mapping unit, for example, Bedford and Lawrence silt loams. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Extremely stony land or Riverwash, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units, and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of woodlands, and engineers.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing short-lived crops and tame pasture; woodland suitability groups, for those who need to manage wooded tracts; the classifications used by engineers who build highways or structures to conserve soil and water; irrigation groups for those who irrigate crops; and groups for building sites for those who are interested in rural development.

General Soil Map

After studying the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the colored general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ from each other in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but distinct patterns of soils. Each pattern normally contains several kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also

Figure 2.—Typical landscape showing an area in association 2. The pasture in the foreground is made up of nearly level to gently sloping Buchanan and Andover soils, and the colluvial slopes are occupied by Laidig, Buchanan, and Andover soils. Blue Mountain is in the background.

be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good sized areas suitable for a certain kind of farming or other land use. It does not show accurately the kinds of soils on a single farm or small tract.

The soil associations in Lehigh County are discussed in the following pages. More detailed information about the soils is given in the section "Descriptions of the Soils."

1. Fleetwood-Extremely Stony Land Association

Soils and land types of the upper slopes of Blue Mountain

This soil association consists of steep, rough areas that are underlain by quartzite, sandstone, and conglomerate. It is made up mainly of soils of the Fleetwood series and of Extremely stony land. The areas lie in a narrow band along the upper slopes of Blue Mountain.

The Fleetwood soils are moderately deep to deep. They are well drained but are low in natural fertility and are generally stony. In most areas of Extremely stony land, there are stones, rock outcrops, and boulder streams on the surface; this land type supports little vegetation.

The soils in this association are not suited to farming. Most of the association is in forest.

2. Laidig-Buchanan-Andover Association

Deep soils of the lower slopes of Blue Mountain

This soil association is made up of undulating to fairly steep areas along the lower slopes of Blue Mountain. Most of the soils are deep and are well drained to moderately well drained, but a few areas are poorly drained. They developed in colluvial material washed from higher areas underlain by sandstone and shale. Much of the association is stony, and small areas are gravelly. Figure 2 shows a typical landscape in this association.

Generally, well-drained Laidig soils occupy the highest areas in this association. The moderately well drained Buchanan soils lie next to the Laidig soils but below them. The poorly drained Andover soils are in depressions and other low areas where seepage water from higher areas accumulates.

Most of this association is poorly suited to farming, although the small, gravelly areas are farmed. Much of the acreage is wooded.

3. Trexler Association

Deep and moderately deep soils of rolling hills on shale

This soil association is on broad ridges and on the less steep parts of hills that are underlain by shale. The areas lie between Blue Mountain and Allentown Valley. The Trexler soils are dominant in the association, but there is a smaller acreage of Comly and Shelmadine soils. A typical landscape showing an area in association 3 is shown in figure 3.

***Figure 3.*—Typical landscape showing a field in association 3. The barley and potatoes are growing in strips across the slope on an area of Trexler shaly silt loam.**

The Trexler soils are moderately deep to deep and are well drained. They developed in glacial till and in frost-churned material weathered from gray shale and sandstone. The Comly soils are moderately well drained to somewhat poorly drained, and the Shelmadine soils are poorly drained. In this association the soils are undulating to steep, but generally the landscape is less rugged than that in soil association 4.

The soils in this association are fairly well suited to cultivation. Most of the association is in crops, mainly corn, potatoes, wheat, oats, and barley, but the steep areas are generally used for pasture. Only a fairly small part of the association is wooded.

4. Montevallo-Trexler, Moderately Shallow, Association

Shallow and moderately deep soils of steep hills on shale

This soil association is on the steep parts of hills that are underlain by shale. It consists mainly of Montevallo soils and of the moderately shallow phases of the Trexler soils, but there is a smaller acreage of deep Trexler soils and of Comly and Shelmadine soils. A typical landscape of this association is shown in figure 4.

The Montevallo soils are steep and shallow. They are well drained, but they are also droughty. The Trexler soils are also well drained, but the moderately shallow Trexler soils are somewhat droughty. The Montevallo and Trexler soils are underlain by shale and slate of the Martinsburg formation and have formed partly in glacial materials. The Comly soils are somewhat poorly drained, and the Shelmadine are poorly drained.

About half of this association is in field crops, and the rough areas are in pasture and trees. Only a few areas are idle. All of the areas that have been cleared are moderately to severely eroded. Potatoes, corn, wheat, oats, and barley are the main crops. Yields are limited by the steep slopes, erosion, moderate natural fertility, and droughtiness.

Figure 4.—Typical landscape showing a field in association 4 where corn and hay have been planted in contour strips. The soil is a moderately shallow Trexler shaly silt loam.

5. Ryder-Duffield Association

Moderately deep and deep soils on shaly limestone

In this association are moderately deep to deep soils that are well drained. The soils are nearly level to rolling and developed on shaly limestone. The Ryder soils and the low clay variant phases of the Duffield soils are dominant in the association, but there is a smaller acreage of moderately well drained Bedford and somewhat poorly drained Lawrence soils.

Deep, open limestone quarries occupy a large part of this association. The soils in the association are excellent for general crops. Most of the farms are used to grow cash crops, but some are used to grow forage crops to feed dairy cattle. Corn, wheat, potatoes, oats, hay, and barley are the main crops grown.

6. Washington-Duffield Association

Deep soils of valleys on limestone

This soil association is made up mainly of soils in a broad, undulating to rolling valley underlain by limestone. The valley lies across the central part of the county and extends in a northeast-southwest direction. In the southeastern part of the county is a smaller area separated by South Mountain from the main valley. The Washington and Duffield soils are dominant in this association, but there is a smaller acreage of Bedford, Lawrence, and Melvin soils.

The Washington soils, developed in material weathered from limestone and glacial till, are deep and well drained. They have varying amounts of sandstone and quartzite gravel on the surface and throughout the profile. The Duffield soils also developed in material weathered from limestone, but the material in which they formed was less affected by glaciation than the parent material of the Washington soils. The Duffield soils are less deep than the Washington soils. They have a finer textured subsoil and contain only a few fragments of stone. The Bedford soils are moderately well drained, the Lawrence soils are somewhat poorly drained, and the Melvin soils are poorly drained.

About 35 percent of this association is in cities, towns, and urban developments or consists of areas of Made land. The highly productive soils and favorable topography make the association generally excellent for agriculture. Except for occasional wet areas or areas of rock outcrops, the soils are farmed intensively.

7. Chester-Brandywine-Fleetwood Association

Deep and moderately deep soils of South Mountain on granite, gneiss, and quartzite

This soil association consists mainly of deep and moderately deep soils of South Mountain. The areas range from level flats in the uplands to steep areas on ridges. The Chester, Brandywine, and Fleetwood are the principal soils, but the Chester soils are predominant. There is a smaller acreage of Glenville, Worsham, and Woodglen soils. A typical landscape in this association is shown in figure 5.

The Chester soils are deep and well drained. They developed on gravelly and clayey glacial material that was derived mainly from granite and granite gneiss and some quartzite. The Chester soils have varying amounts of fragments of rock on the surface and throughout the profile. The Brandywine soils are on the steep slopes. They are well drained and gravelly and are shallow to moderately deep over bedrock. These Brandywine soils formed in material weathered from granitic gneiss, granite, and quartz-monzonite. The Fleetwood soils are moderately deep to deep and are also well drained. They developed principally in material weathered from quartzite, and they occupy small areas near the Chester and Brandywine soils.

The moderately well drained to somewhat poorly drained Glenville, the poorly drained Worsham, and the very poorly drained Woodglen soils are in low areas where water from higher areas accumulates on the surface. Runoff is slow on these soils, and water moves slowly through the profile. As a result, the water table is high.

Figure 5.—Typical landscape showing areas of level to sloping Chester, Glenville, and Worsham soils in association 7; the pastures in the foreground consist of Worsham and Glenville soils, and the field in the background, where corn, wheat, and hay are growing, is made up of Chester soils.

About half of this association is used for crops, and the rest is in pasture and trees. Farming is generally diversified, but a few farms are entirely in orchards. Dairying is common, and poultry is raised on a few farms. Some of the small farms are operated part time by the owner. Generally, the well-drained soils in this association are well suited to the crops commonly grown in the area. In most places the poorly drained to very poorly drained soils are used for pasture; some of the acreage on most farms is used for improved pasture.

8. Murrill Association

Deep soils of the lower slopes of South Mountain

This association consists of deep, well-drained, productive Murrill soils. These soils lie in a narrow belt along the northern side of South Mountain. They developed on colluvium and alluvium derived from soils underlain by quartzite, granite, and gneiss. The materials washed or rolled down South Mountain. They were deposited on the lower slopes of the mountain over soils formed in material weathered from limestone. In the eastern part of this association are some areas where the parent material consisted partly of glacial till.

The Murrill soils have fragments of rock on the surface and throughout the profile. In most places they contain gravel, but in some places they are stony. Near the Murrill soils are the moderately well drained Bedford and the poorly drained Melvin soils.

About half of this association is used for crops.

9. Fleetwood-Chester Very Stony Association

Deep and moderately deep, stony soils of the ridges of South Mountain on quartzite and gneiss

This soil association is made up of deep and moderately deep, very stony soils. The soils lie in a narrow belt across the southern part of the county near South Mountain. They consist mainly of very stony Chester and Fleetwood soils, which developed in material weathered from quartzite, granite gneiss, and gneiss. The topography is one of gently rolling hills to steep ridges, but the areas are predominantly on steep ridges.

Stones and steep slopes make this association poorly suited to most types of agriculture. The association is mostly in trees, to which the soils are well suited. Yellow-poplar, red maple, black birch, and various kinds of oaks are the most common trees.

10. Penn-Norton-Readington Association

Soils on red Triassic sandstone and shale

This soil association is in a fairly narrow area that lies across the extreme southern part of the county. The soils overlie red Triassic sandstone and shale. The Penn, Norton, and Readington soils are the principal ones in the association, but there is a smaller acreage of Croton soils. The areas are rolling to steep.

The Penn soils are moderately deep to shallow and are well drained. They formed in material weathered from red Triassic shale, conglomerate, and sandstone. The soils have varying amounts of shale on the surface and throughout the profile, and in some places they are sandy and gravelly. The Norton soils are on the less steep areas of the association and are deep and well drained. They formed from materials similar to those in which the Penn soils developed, but they contain fewer fragments of rock and their subsoil is better developed. The Readington and Croton soils also formed from similar parent materials. The Readington soils are moderately well drained to somewhat poorly drained, and the Croton soils are poorly drained.

The Norton soils are the most productive of the soils in this association. They are easy to work and are used for general farm crops. The Penn soils are less productive than the Norton because they are droughty and have less favorable topography. Much of the acreage of the Penn soils is wooded.

11. Montalto Association

Deep soils of ridges on diabase

This soil association occupies only a small acreage in the county. It consists of deep, well-drained soils on ridges underlain by diabase. The areas are scattered to the south of South Mountain where diabase has intruded into the formations of Triassic rocks. The soils are gently rolling to steep, and the steep areas are generally stony. The Montalto soils predominate. There is a smaller acreage of Penn and Norton soils.

Most of the Montalto soils are productive and are suited to all the general farm crops grown in the area. Nearly all of the acreage of very stony Montalto soils is wooded.

Use and Management of the Soils

The dominant problems of use and management vary somewhat in different parts of the county. In the northern half of the county, except on Blue Mountain, the dominant soils are moderately deep or deep over gray shale. The most important problems of management are the improvement and maintenance of fertility and the control of erosion.

In the broad valley north of South Mountain, most of the soils are deep over limestone. South of South Mountain are smaller areas of deep soils over gneiss, schist, or granite, and other areas that are deep over limestone. Also, across most of the southern end of the county are moderately deep or deep soils over red shale. In all of these areas, the most important problems of management are the improvement and maintenance of fertility and the control of erosion. In addition, however, some supplemental drainage is needed on many farms.

Except for some soils on flood plains, most soils throughout the county need lime for good yields of legumes.

In the following pages the use and management of the soils is described in considerable detail. First, the system of capability classification used by the Soil Conservation Service is explained. Then, management of groups of soils, the capability units, is described and information about the relative productivity of the soils in the county is given. This is followed by a discussion of management of the soils for woodland, for wildlife, and for engineering. Finally, there is a discussion of the soils in relation to suburban developments.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on the limitations of the soils, on the risk of damage when they are used, and on the way they respond to treatment.

In this system all the kinds of soils are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *s*, *w*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; *w* means that water in or on the soil will interfere with the growth of plants or with cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *c*, used in only some parts of the country, indicates that the chief limitation is a climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c* because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, woodland, or wildlife.

Within the subclasses are the capability units, groups of soil enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for many statements about management of soils. Capability units are generally identified by Arabic numbers assigned locally, for example, IIe–1 or IIIe–2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations. The grouping does not take into consideration major, and generally expensive, landforming that would change the slope, depth, or other characteristics of the soil. It also does not take into consideration possible, but unlikely, major reclamation projects.

The capability classes, subclasses, and units in Lehigh County are described in the list that follows:

Class I.—Soils that have few limitations that restrict their use.

- Unit I–1.—Deep, level or nearly level, well-drained soils on limestone.
- Unit I–2.—Deep, level, or nearly level, well-drained, gravelly or shaly soils on granite, gneiss, shale, sandstone, or old alluvium.
- Unit I–3.—Deep, level or nearly level, well-drained soil on recent alluvium of flood plains.

Class II.—Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe.—Soils subject to moderate erosion if they are not protected.

- Unit IIe–1.—Deep and moderately deep, nearly level to gently sloping, well-drained soils on limestone or basic rocks.
- Unit IIe–2.—Deep or moderately deep, nearly level to gently sloping, well-drained soils on granite, shale, sandstone, colluvium or old alluvium.
- Unit IIe–3.—Moderately deep to shallow, nearly level to gently sloping, well-drained soils on noncalcareous material.
- Unit IIe–4.—Deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained soils on sandstone, schist, gneiss, shale, and limestone.

Subclass IIw.—Soils that have moderate limitations because of excess water.

- Unit IIw–1.—Deep, nearly level, moderately well drained to somewhat poorly drained soils on shale, sandstone, and limestone.
- Unit IIw–2.—Deep, nearly level, moderately well drained to somewhat poorly drained soils of flood plains.

Class III.—Soils that have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

- Unit IIIe–1.—Deep and moderately deep, moderately sloping, well-drained soils on limestone or basic rocks.
- Unit IIIe–2.—Deep, gently sloping and moderately sloping, well-drained, gravelly soils over granitic gneiss, shale, sandstone, and old terrace material.
- Unit IIIe–3.—Moderately deep to shallow, gently sloping and moderately sloping, gravelly and shaly soils.
- Unit IIIe–4.—Deep, moderately sloping, moderately well drained soils.

Subclass IIIw.—Soils that have severe limitations because of excess water.

- Unit IIIw–1.—Nearly level, somewhat poorly drained to very poorly drained soils that have a slowly permeable subsoil.
- Unit IIIw–2.—Nearly level, poorly drained soils of flood plains.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

- Unit IVe–1.—Deep and moderately deep, moderately sloping to moderately steep soils on limestone and basic rocks.
- Unit IVe–2.—Deep, moderately sloping to moderately steep, well-drained soils on granite, gneiss, and shale.

Unit IVe–3.—Moderately deep to shallow, moderately sloping to moderately steep, well-drained soils on granite, gneiss, sandstone, quartzite, and shale.

Subclass IVw.—Soils that have very severe limitations for cultivation because of excess water.

Unit IVw–1.—Nearly level to moderately sloping, poorly drained soils that have a slowly permeable subsoil.

Class V.—Soils not likely to erode but that have other limitations, which are impractical to remove, that limit their use largely to pasture, woodland, or wildlife food and cover.

Subclass Vw.—Soils too wet for cultivation; drainage or protection not feasible.

Unit Vw–1.—Deep, nearly level to gently sloping, poorly drained soils that are slowly permeable.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, to woodland, or to wildlife food and cover.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIe–1.—Deep or moderately deep, moderately steep to steep, well-drained soils.

Unit VIe–2.—Moderately deep to shallow, moderately steep to steep, well-drained soils.

Subclass VIs.—Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Unit VIs–1.—Deep to moderately deep, gently sloping to moderately steep, well drained and moderately well drained soils that are very stony.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Unit VIIe–1.—Deep to moderately deep, steep to very steep, well-drained soils.

Unit VIIe–2.—Shallow to moderately deep, steep to very steep, well-drained soils.

Subclass VIIs.—Soils very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs–1.—Deep, steep to very steep, well-drained soils that are very stony.

Unit VIIs–2.—Nearly level to gently sloping, poorly drained to very poorly drained soils that are very stony.

Class VIII.—Soils and landforms that have limitations that preclude their use for commercial production of plants and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs.—Rock or soil materials that have little potential for production of vegetation.

Unit VIIIs–1.—Extremely stony land types, gravel pits, and slate dumps.

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Management by Capability Units

The soils in one capability unit have about the same limitations and similar risks of damage. All of the soils in one unit, therefore, need about the same kind of management, though they may have formed from different kinds of parent material and in different ways.

The capability units are described in the following pages. The soils in each unit are listed, and management suitable for all the soils in one unit is suggested. Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service, the county agricultural agent, or a member of the staff of the State Agricultural Experiment Station.

Suitable crop rotations are described for each unit in terms of high, low, or medium intensity. Types of rotations and suitable crops are described under some of the mapping units in the section "Descriptions of the Soils." The intensity of the rotations is defined as follows:

1. High-intensity (2-year) rotation: 1 year of a row crop followed by a cover crop in winter, and then 1 year of a small grain followed by a green-manure crop or its equivalent; the soils need to be limed and fertilized properly if this kind of rotation is used.
2. Medium-intensity (3-year) rotation: 1 year of a row crop followed by a cover crop in winter, and then 1 year of a small grain followed by 1 year of a hay crop or its equivalent; the soils need to be limed and fertilized properly if this kind of rotation is used.
3. Low-intensity (4- or 5-year) rotation: 1 year of a row crop followed by a cover crop in winter, then 1 year of a small grain, and, finally, 2 to 3 years of hay or its equivalent; the soils need to be limed and fertilized properly if this kind of rotation is used.

Capability unit I–1

In this unit are deep, level or nearly level, well-drained soils on limestone material or on material influenced by limestone. These soils are medium textured and have moderate permeability. They hold a large amount of moisture available to plants. The soils are moderately acid to neutral and are high in natural fertility. There is a slight hazard of erosion. The following soils are in this unit:

Duffield silt loam, low clay variant, 0 to 3 percent slopes.
Elk silt loam, 0 to 3 percent slopes.
Washington silt loam, 0 to 3 percent slopes.

These soils are suited to corn, small grains, alfalfa, vegetables, and other farm crops commonly grown in the county. A crop rotation of high intensity can be used if special attention is given to maintaining organic matter and the structure of the soil. Crop residues need to be turned under, and tillage should be kept to a minimum. Apply lime and fertilizer according to the results of soil tests and the needs of the crop to be grown.

Capability unit I–2

In this unit are deep, level or nearly level, well-drained, gravelly or shaly soils on material from granite, gneiss, shale, sandstone, and old alluvium. These soils are medium textured. They are moderate in permeability and

hold a moderate amount of moisture available to plants. The soils are moderately acid and are low to medium in natural fertility. The hazard of erosion is slight. The following soils are in this unit:

Norton silt loam, 0 to 3 percent slopes.
Trexler shaly silt loam, 0 to 3 percent slopes.
Wheeling gravelly loam, 0 to 3 percent slopes.

These soils are suited to corn, small grains, alfalfa, vegetables, and other crops commonly grown in the county. The content of organic matter can be kept high and good soil structure can be maintained if a rotation of high intensity is used. Crop residues need to be turned under, and tillage should be kept to a minimum. Apply lime and fertilizer according to the results of soil tests and the needs of the crop to be grown. Generally, a large amount of lime needs to be added in the first application.

Capability unit I–3

Only one soil—Huntington silt loam—is in this unit. This is a deep, level or nearly level, well-drained soil on recent alluvium of the flood plains. It lies along Jordan Creek and along Lehigh River in Salisbury Township. This soil is medium textured, has moderate permeability, and holds a large amount of moisture available to plants. It is nearly neutral and is high in natural fertility. There is a slight hazard of overflow. The floodwaters remain for only a short time and normally cause little damage.

This soil is suited to corn, small grains, alfalfa, and vegetables. A rotation of high intensity can be used if the content of organic matter is kept high, good soil structure is maintained, and tillage is kept to a minimum. Leave crop residues standing on the soil throughout the winter. Apply lime according to the results indicated by soil tests and the needs of the crop to be grown. Generally, only a small amount of lime needs to be added in the first application.

Capability unit IIe–1

In this unit are nearly level to gently sloping, well-drained soils on material from limestone or basic rocks. Most of the soils are deep, but the Ryder soils are moderately deep. All of the soils hold a large amount of moisture available to plants. Permeability is moderate in the surface layer and moderate to moderately slow in the subsoil. The soils are moderately acid to nearly neutral and are moderate to high in natural fertility. They are slightly to moderately eroded. The following soils are in this unit:

Duffield silt loam, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, 3 to 8 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 3 to 8 percent slopes.
Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded.
Made land, limestone material, 0 to 3 percent slopes.
Made land, limestone material, 3 to 8 percent slopes.
Montalto silt loam, 3 to 8 percent slopes, moderately eroded.
Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded.
Ryder silt loam, 0 to 3 percent slopes.
Ryder silt loam, 3 to 8 percent slopes, moderately eroded.
Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded.
Washington silt loam, 0 to 3 percent slopes, moderately eroded.
Washington silt loam, 3 to 8 percent slopes.
Washington silt loam, 3 to 8 percent slopes, moderately eroded.

These soils are suited to corn, small grains, alfalfa, vegetables, and other farm crops commonly grown in the county. Using a rotation of medium intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help to control erosion on these soils. If a row crop is grown, return the crop residues to the soil or grow a cover crop after the row crop. Add sufficient fertilizer, and apply lime according to the results indicated by soil tests.

Capability unit IIe–2

This unit is made up of deep or moderately deep, well-drained soils that are nearly level to gently sloping. The soils overlie colluvium, old alluvium, or material from granite, shale, and sandstone. They have moderate to moderately rapid permeability and hold a moderate to large amount of moisture available for plants to use. These soils are moderately acid and are moderate in natural fertility. They are slightly to moderately eroded. The following soils are in this unit:

Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded.
Chester gravelly silt loam, 3 to 8 percent slopes.
Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded.
Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded.
Made land, granitic material, 0 to 8 percent slopes.
Norton silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded.

These soils are suited to corn, potatoes, small grains, alfalfa, and other crops commonly grown in the county, and they are also suited to orchards. Using a rotation of medium intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help to control erosion. If a row crop is grown, return the residues to the soil after the row crop is harvested or grow a cover crop. Apply lime and fertilizer according to the results of soil tests. These soils generally require a moderately large amount of lime in the first application.

Capability unit IIe–3

In this unit are nearly level to gently sloping soils that are well drained. The soils are moderately deep to shallow over noncalcareous material from quartzite, gneiss, shale, and sandstone. They have moderate to moderately rapid permeability, and the amount of moisture they hold available for plants is very low or low. These soils are medium acid to strongly acid and are moderate to low in natural fertility. They are slightly to moderately eroded. The following soils are in this unit:

Brandywine loam, 3 to 8 percent slopes, moderately eroded.
Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded.
Made land, shale material, 0 to 8 percent slopes.
Penn shaly silt loam, 3 to 8 percent slopes.
Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded.

These soils are suited to corn, small grains, birdsfoot trefoil, and other farm crops commonly grown in the county. In dry years, yields of crops grown on them are

generally much lower than in years of normal rainfall. Using a rotation of medium intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help to control erosion. If a row crop is grown, turn under the crop residues or grow a cover crop after the row crop. Apply lime and fertilizer according to the results of soil tests. A moderately large amount of lime generally needs to be added in the first application.

Capability unit IIe–4

This unit consists of deep, nearly level to gently sloping soils that are moderately well drained to somewhat poorly drained. The soils formed in material from sandstone, schist, gneiss, shale, and limestone. They have moderate permeability in the surface layer and moderately slow permeability in the subsoil. The amount of moisture they hold available to plants is moderate to high. These soils are moderately acid to nearly neutral and are moderate in natural fertility. They are slightly to moderately eroded. The following soils are in this unit:

Bedford silt loam, 3 to 8 percent slopes.
Bedford silt loam, 3 to 8 percent slopes, moderately eroded.
Buchanan gravelly loam, 3 to 8 percent slopes.
Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded.
Comly silt loam, 3 to 8 percent slopes.
Comly silt loam, 3 to 8 percent slopes, moderately eroded.
Glenville silt loam, 0 to 3 percent slopes, moderately eroded.
Glenville silt loam, 3 to 8 percent slopes.
Glenville silt loam, 3 to 8 percent slopes, moderately eroded.
Monongahela silt loam, 3 to 8 percent slopes, moderately eroded.
Readington silt loam, 3 to 8 percent slopes.
Readington silt loam, 3 to 8 percent slopes, moderately eroded.

These soils are suited to corn, small grains, birdsfoot trefoil, and other farm crops commonly grown in the county. Alfalfa can be grown satisfactorily in a short rotation. A rotation of medium intensity, graded stripcropping, well-sodded waterways, diversion terraces, and a minimum amount of tillage will help to control erosion. The soils can also be protected by returning crop residues to the soil or growing a cover crop in winter. Apply lime and fertilizer according to the results of soil tests. A moderately large amount of lime should be added in the first application.

Drainage terraces and graded strips can be used to help remove excess surface water and to help drain the soils without causing erosion. Sod the waterways and establish outlets before building the terraces. Tile drains can also be used to remove excess water from the soils if adequate outlets are available.

Capability unit IIw–1

In this unit are deep, nearly level, moderately well drained to somewhat poorly drained soils on shale, sandstone, and limestone. Permeability is moderate in the surface layer and moderately slow in the subsoil. The lower part of the subsoil generally has a mottled, compact layer that impedes the downward movement of water and keeps the soils wet. The soils hold a moderate to large amount of moisture available for plants to use. They are moderately acid to nearly neutral and are moderate in natural fertility. The soils are only slightly eroded. The following soils are in this unit:

Bedford silt loam, 0 to 3 percent slopes.
Comly silt loam, 0 to 3 percent slopes.
Glenville silt loam, 0 to 3 percent slopes.
Monongahela silt loam, 0 to 3 percent slopes.
Readington silt loam, 0 to 3 percent slopes.

These soils are suited to corn, small grains, birdsfoot trefoil, and other farm crops commonly grown in the area, but they are not well suited to alfalfa, winter grain, or potatoes. The content of organic matter can be kept high and good soil structure can be maintained if a rotation of medium intensity is used, tillage is kept to a minimum, and crop residues are turned under or a cover crop is grown in winter. Row crops should be grown in graded strips to help control erosion and to provide surface drainage on slopes of more than 2 percent. Surface drainage as well as internal drainage are needed for best yields. Apply lime and fertilizer according to the results of soil tests.

Capability unit IIw–2

This unit is made up of deep, nearly level, moderately well drained to somewhat poorly drained soils of flood plains. The soils have moderate permeability. They hold a large amount of moisture available for plants to use. The soils are moderately acid to nearly neutral and are moderate to high in natural fertility. These soils are subject to occasional flooding and have a high water table during part of the year. The following soils are in this unit:

Lindside silt loam.
Philo silt loam.

These soils are suited to corn, spring small grains, birdsfoot trefoil, and other farm crops that are commonly grown. A rotation of high intensity can be used if tillage is kept to a minimum, cover crops are grown, and organic matter and good soil structure are maintained. Leave crop residues standing on the soils throughout the winter. Drainage is required for best yields. Add fertilizer, and apply lime according to the results of soil tests.

Capability unit IIIe–1

In this unit are moderately sloping, well-drained soils on material from limestone and basic rocks. Most of the soils are deep, but the Ryder soil is moderately deep. The permeability in all of the soils is moderate in the surface layer and moderate to moderately slow in the subsoil. These soils are high in available moisture capacity. They are moderately acid to nearly neutral and are moderate to high in natural fertility. The soils are moderately eroded. The following soils are in this unit:

Duffield silt loam, 8 to 15 percent slopes, moderately eroded.
Montalto silt loam, 8 to 15 percent slopes, moderately eroded.
Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded.
Ryder silt loam, 8 to 15 percent slopes, moderately eroded.
Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded.
Washington silt loam, 8 to 15 percent slopes.
Washington silt loam, 8 to 15 percent slopes, moderately eroded.

These soils are suited to corn, small grains, alfalfa, and other commonly grown farm crops. Using a rotation of low intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help to

control erosion. If row crops are grown, return the crop residues to the soil or grow a cover crop after a row crop to help protect the soil. Apply lime and fertilizer according to the results of soil tests.

Capability unit IIIe-2

In this unit are deep, gently sloping and moderately sloping, gravelly and shaly soils that are well drained. The soils overlie granitic gneiss, shale, sandstone, and old terrace material. They have moderate to moderately rapid permeability and hold a moderate to large amount of moisture available to plants. The soils are moderately acid and are moderate in natural fertility. Erosion is moderate to severe. The following soils are in this unit:

Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded.
Chester gravelly silt loam, 8 to 15 percent slopes.
Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded.
Norton silt loam, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded.

These soils are suited to corn, small grains, alfalfa, and other commonly grown farm crops. They are well suited to orchards. Using a rotation of low intensity, contour stripcropping, and diversion terraces, and keeping tillage to a minimum will help to control erosion. Return crop residues to the soil or grow a cover crop in winter. Add fertilizer, and apply lime according to the results of soil tests. These soils generally require a moderately large amount of lime in the first application.

Capability unit IIIe-3

In this unit are gently sloping and moderately sloping, gravelly and shaly soils that are well drained. The soils are moderately deep to shallow over quartzite, gneiss, schist, shale, and sandstone. They have moderate to moderately rapid permeability. The amount of moisture they hold available to plants is very low or low. These soils are moderately acid to strongly acid and are moderate to low in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Brandywine loam, 8 to 15 percent slopes, moderately eroded.
Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded.
Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded.
Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded.

These soils are suited to corn, small grains, birdsfoot trefoil, and other commonly grown farm crops, and they are also suited to orchards. Using a rotation of low intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help control erosion. In addition, the soils can be protected by returning crop residues to the soil or growing a cover crop after a row crop. Add the proper kinds and amounts of fertilizer, and apply lime according to the results of soil tests. These soils generally require moderately large amounts of lime in the first application.

Capability unit IIIe-4

In this unit are deep, moderately sloping soils that are moderately well drained. The soils overlie shale, sandstone, gneiss, and schist. They have moderate permeability in the surface layer and moderately slow permeability in the subsoil. The amount of moisture they hold available to plants is moderate to high. The soils are moderately acid and are moderate in natural fertility. They are moderately eroded. The lower part of the subsoil is generally fine textured and impedes the downward movement of water and the penetration of roots. As the result of seepage, most of these soils are wet and are slow to dry in spring. The following soils are in this unit:

Comly silt loam, 8 to 15 percent slopes, moderately eroded.
Glenville silt loam, 8 to 15 percent slopes.
Glenville silt loam, 8 to 15 percent slopes, moderately eroded.
Readington silt loam, 8 to 15 percent slopes, moderately eroded.

These soils are suited to corn, small grains, birdsfoot trefoil, and other farm crops that are commonly grown. They are not well suited to alfalfa, potatoes, or other crops that will not tolerate a temporarily high water table. Using a rotation of low intensity, contour stripcropping, and diversion terraces, and also keeping tillage to a minimum will help to control erosion. The soils can also be protected by returning crop residues to the soil or growing a cover crop after a row crop. Apply the proper amounts and kinds of fertilizer, and apply lime according to the results indicated by soil tests. These soils generally require a moderately large amount of lime in the first application.

Capability unit IIIw-1

In this unit are nearly level, somewhat poorly drained to very poorly drained soils that have a slowly permeable subsoil. These soils are in low areas, in depressions, and along drainageways. The areas are small and are within areas of better drained soils. The soils are medium acid to nearly neutral, and they have high natural fertility. Erosion is generally not a problem. Seepage from the higher slopes and a high water table keep the soils waterlogged for long periods. The Woodglen soils are wet during practically all of the year. The following soils are in this group:

Bedford and Lawrence silt loams, 0 to 3 percent slopes.
Bedford and Lawrence silt loams, 3 to 8 percent slopes.
Melvin silt loam, local alluvium, 0 to 3 percent slopes.
Melvin silt loam, local alluvium, 3 to 8 percent slopes.
Woodglen silt loam, 0 to 3 percent slopes.
Woodglen silt loam, 3 to 8 percent slopes.

If these soils are not drained, they are probably best suited to hay or to pasture containing birdsfoot trefoil. If they are used for row crops, use tile drains or bedding to provide drainage. Diversion terraces can be used to protect them from runoff from other areas. Delay using the areas for pasture until the soils have dried enough to prevent damage by trampling. To get high yields of forage, add the proper kinds and amounts of fertilizer and apply lime according to the needs indicated by soil tests.

Capability unit IIIw–2

In this unit are nearly level, poorly drained soils of flood plains. These soils are medium acid to nearly neutral, and they are moderate to high in natural fertility. Erosion is not a problem. The soils are on the lower parts of flood plains. They are subject to frequent overflow, but crops are seldom damaged by flooding. These soils have a permanent high water table unless they are drained. The following soils are in this unit:

Atkins silt loam.
Atkins silt loam, local alluvium, 0 to 3 percent slopes.
Melvin silt loam.

If these soils are not drained, they are probably best suited to hay or to pasture containing birdsfoot trefoil. Drainage is required before cultivated crops can be grown. The content of organic matter can be kept high and good soil structure can be maintained if a rotation of medium intensity is used, tillage is kept to a minimum, cover crops are grown, and the proper kinds and amounts of fertilizer are added. Leave crop residues standing on the soils throughout the winter. Apply lime according to the needs indicated by soil tests.

Capability unit IVe–1

In this unit are moderately sloping to moderately steep, well-drained soils on material from limestone and basic rocks. Most of the soils are deep, but the Ryder soil is moderately deep. These soils have moderate permeability in the surface layer and moderate to moderately slow permeability in the subsoil. They hold a moderate to large amount of moisture available for plants to use. The soils are medium acid to nearly neutral and are moderate to high in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Duffield silt loam, 15 to 25 percent slopes, moderately eroded.
Made land, limestone material, 8 to 25 percent slopes.
Montalto silt loam, 8 to 15 percent slopes, severely eroded.
Montalto silt loam, 15 to 25 percent slopes, moderately eroded.
Murrill gravelly loam, 8 to 15 percent slopes, severely eroded.
Ryder silt loam, 8 to 15 percent slopes, severely eroded.
Washington silt loam, 8 to 15 percent slopes, severely eroded.
Washington silt loam, 15 to 25 percent slopes, moderately eroded.

These soils are suited to corn, small grains, alfalfa, and other commonly grown farm crops, and they are also suited to orchards. Because of the strong slopes and hazard of erosion, however, these soils should be cultivated no oftener than once in every 4 or 5 years. The soils are well suited to mixtures of grasses and legumes. They can also be protected by turning under crop residues and using contour stripcropping and diversion terraces. These soils need to be fertilized and limed according to the needs indicated by soil tests.

Capability unit IVe–2

In this group are deep, moderately sloping to moderately steep, well-drained soils on material from granite, gneiss, and shale. These soils have moderate to moderately rapid permeability. They hold a moderate amount of moisture available for plants to use. The soils are medium acid, and they are moderate in natural fertility. Some of the soils are only slightly eroded, but in others erosion has been moderate or severe. The following soils are in this unit:

Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded.
Chester gravelly silt loam, 15 to 25 percent slopes.
Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded.
Made land, granitic material, 8 to 25 percent slopes.
Made land, shale material, 8 to 25 percent slopes.
Norton silt loam, 15 to 25 percent slopes, moderately eroded.

These soils are suited to corn, small grains, alfalfa, and other farm crops that are commonly grown, but they are better suited to perennial hay. They are also suited to orchards. Contour stripcropping, diversion terraces on slopes of as much as 15 percent, and tillage only once every 4 or 5 years when reseeding for hay will help to control erosion. Apply lime and fertilizer according to the needs indicated by soil tests. The soils generally require moderately large amounts of lime in the first application.

Capability unit IVe–3

In this unit are moderately deep to shallow, moderately sloping to moderately steep, well-drained soils on material from granite, quartzite, gneiss, sandstone, and shale. These soils have moderate to rapid permeability. The amount of moisture they hold available to plants is low to very low. The soils are medium acid to strongly acid and moderate to low in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Brandywine loam, 8 to 15 percent slopes, severely eroded.
Brandywine loam, 15 to 25 percent slopes, moderately eroded.
Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded.
Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded.
Penn shaly silt loam, 8 to 15 percent slopes, severely eroded.
Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded.

Because of the hazard of further erosion, the soils of this unit are better suited to hay, small grains, or orchards than to row crops. The areas can be cultivated occasionally to help in establishing new seedings. Contour stripcropping, diversion terraces, and grassed waterways are needed on slopes that are longer than 300 feet to help control erosion and to conserve moisture. Applying adequate lime and fertilizer will help to keep the grass and legumes growing vigorously.

Capability unit IVw–1

In this unit are nearly level to moderately sloping, poorly drained soils that have a slowly permeable subsoil. These soils are at the heads of narrow streams, in depressions, and in other low areas. They are medium acid and are moderate to low in natural fertility. Erosion is generally not a problem, but in some places the large amount of water from higher areas is likely to cause moderate erosion. Because of seepage and a permanent

high water table, these soils are waterlogged most of the time. The following soils are in this unit:

Croton silt loam, 0 to 3 percent slopes.
Croton silt loam, 3 to 8 percent slopes.
Shelmadine silt loam, 0 to 3 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded.
Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded.

These soils are suited to birdsfoot trefoil, timothy, and other crops that tolerate wetness. They are probably best used for hay, but a cultivated crop can be grown occasionally if open drains, bedding, or similar surface drains are provided. Applying adequate amounts of lime and fertilizer will lengthen the life of a stand of forage plants. Apply lime and fertilizer according to the needs indicated by soil tests.

Capability unit Vw–1

In this unit are deep, nearly level to gently sloping, poorly drained soils that are slowly permeable. The soils occupy low areas in the uplands. They have moderate to low available moisture-holding capacity and are medium acid and moderate in fertility. The soils remain wet throughout much of the year, and the wetness is difficult to remedy without major reclamation. The sloping soils are subject to erosion. All of the soils are sticky when wet, are very hard when dry, and are easily compacted by livestock or machinery. Their use is limited largely to pasture, woodland, and wildlife. The following soils are in this unit:

Worsham silt loam, 0 to 3 percent slopes.
Worsham silt loam, 0 to 3 percent slopes, moderately eroded.
Worsham silt loam, 3 to 8 percent slopes.
Worsham silt loam, 3 to 8 percent slopes, moderately eroded.

These soils can be used for pasture consisting of plants that tolerate wetness. Improving drainage, maintaining a high content of organic matter, and adding to the supply of plant nutrients will help increase the use of the soils. In some places diversion terraces and open drains can be used to improve drainage. In the level and nearly level areas, bedding can be used. Tile drains are generally impractical to use, because of the heavy, impermeable subsoil.

Capability unit VIe–1

In this unit are moderately steep to steep, well-drained soils on material from gneiss, shale, and limestone. Most of the soils are deep over bedrock, but the Ryder soil is only moderately deep. In all of the soils, permeability is moderate in the surface layer and moderately slow in the subsoil. The amount of available moisture is moderate. The soils are medium acid to nearly neutral and are moderate in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded.
Chester gravelly silt loam, 25 to 35 percent slopes.
Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded.
Duffield silt loam, 15 to 25 percent slopes, severely eroded.
Duffield silt loam, 25 to 35 percent slopes, moderately eroded.
Montalto silt loam, 15 to 25 percent slopes, severely eroded.
Ryder silt loam, 15 to 25 percent slopes, severely eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded.

These soils are suited to birdsfoot trefoil, bluegrass, and similar crops that provide ground cover. They are probably best suited to pasture or to use as woodland. Reseeding the pastures in narrow contour strips will help to control erosion. Fertilizing the soils properly and adding lime will lengthen the life of the stands of forage plants. Apply lime and fertilizer according to results indicated by soil tests. Moderately large amounts of lime are generally needed in the first application.

Capability unit VIe–2

In this unit are moderately deep to shallow, well-drained soils on material from quartzite, gneiss, sandstone, and shale. Most of the soils are moderately steep to steep, but the severely eroded Montevallo soil has only moderate slopes. All of the soils have moderate to rapid permeability. The amount of moisture they hold available to plants is low to very low. These soils are medium acid to strongly acid and are moderate to low in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Brandywine loam, 15 to 25 percent slopes, severely eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded.
Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded.
Penn shaly silt loam, 15 to 25 percent slopes, severely eroded.
Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded.

These soils are suited to birdsfoot trefoil, bluegrass, and similar crops that provide ground cover. They are probably best suited to pasture or to use as woodland, but in some summers there may be insufficient moisture for pasture plants. Reseeding the pastures in narrow contour strips will help to control erosion and will also help to retain moisture for new seedings. Fertilizing the soils properly and adding lime will lengthen the life of the stands of forage plants. Apply lime according to the needs indicated by soil tests. Yields are likely to be low in dry years because of the small amount of moisture held in the soils.

Capability unit VIs–1

In this unit are deep to moderately deep, gently sloping to moderately steep, moderately well drained and well drained soils that are very stony. These soils developed in material from granite, quartzite, sandstone, and diabase. They have moderate to moderately rapid permeability and hold a moderate to large amount of moisture available to plants. These soils are strongly acid to medium acid. Erosion is generally not a problem, because of good ground cover. The following soils are in this unit:

Buchanan very stony loam, 0 to 8 percent slopes.
Buchanan very stony loam, 8 to 25 percent slopes.
Chester very stony silt loam, 0 to 8 percent slopes.
Chester very stony silt loam, 8 to 25 percent slopes.
Fleetwood very stony loam, 0 to 8 percent slopes.
Fleetwood very stony loam, 8 to 25 percent slopes.
Laidig very stony loam, 0 to 8 percent slopes.
Laidig very stony loam, 8 to 25 percent slopes.

Montalto very stony loam, 0 to 8 percent slopes.
Montalto very stony loam, 8 to 25 percent slopes.
Montevallo very rocky silt loam, 8 to 25 percent slopes.
Murrill very stony loam, 0 to 8 percent slopes.
Murrill very stony loam, 8 to 25 percent slopes.

Because of the many large stones, these soils are suited only to pasture or woodland. Where it is feasible to use light farm equipment, stands of mature bluegrass and whiteclover ought to be fertilized and limed. Apply lime according to the needs indicated by soil tests. Control of weeds and brush may be difficult. Cleared areas that are not being used for pasture should probably be used for trees.

Capability unit VIIe–1

In this unit are steep to very steep, well-drained soils on material from gneiss, diabase, and limestone. All of the soils, except the Ryder soil, are deep over bedrock, but the Ryder soil is only moderately deep. In all of the soils, permeability is moderate in the surface layer and moderately slow in the subsoil. The soils hold a moderate amount of moisture available for plants. They are medium acid to nearly neutral and are moderate in natural fertility. Erosion is moderate to severe. The following soils are in this unit:

Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded.
Duffield silt loam, 35 to 55 percent slopes, moderately eroded.
Montalto silt loam, 25 to 35 percent slopes, severely eroded.
Ryder silt loam, 25 to 35 percent slopes, severely eroded.

The soils of this unit are too steep and eroded to be used for cultivated crops or pasture. They are fairly well suited, however, to growing trees and to use as habitats for wildlife. The areas require protection from fire and grazing if best yields of timber are to be obtained. Selective cutting and improvement cutting will improve the quality and quantity of the timber. Plantations of trees should be thinned and pruned in accordance with the recommendations of a professional forester. The soils in this unit also can be used for trees and shrubs to provide food and cover for some kinds of wildlife.

Capability unit VIIe–2

In this group are shallow to moderately deep, steep to very steep, well-drained soils on material from quartzite, gneiss, shale, and sandstone. The soils have moderate to rapid permeability. The amount of moisture they hold available for plants is low to very low. The soils are medium acid to strongly acid and are moderate to low in natural fertility. They are moderately to severely eroded. The following soils are in this unit:

Brandywine loam, 25 to 35 percent slopes, severely eroded.
Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded.
Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded.
Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded.
Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded.
Penn shaly silt loam, 25 to 40 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded.

Because of their steep slope and severe erosion, the soils of this unit are not suitable for farming. They are only fair for timber because of their low moisture-holding capacity. Trees ought to be planted on the sites that have been cleared. The trees need protection from fire, and the areas should be fenced to protect them from grazing. Selective harvesting and improvement cutting will increase the quality of the stands. The soils in this unit also can be used for shrubs to provide food and cover for some kinds of wildlife.

Capability unit VIIs–1

In this unit are steep to very steep, deep, well-drained soils that are very stony. These soils developed in material from shale, granite, gneiss, and quartzite. They have moderate permeability. The amount of moisture they hold available for plants is moderate to high. These soils are medium acid and are moderate in natural fertility. Unless they are cleared of trees and stones, erosion is generally not a problem. The following soils are in this unit:

Chester very stony silt loam, 25 to 50 percent slopes.
Fleetwood very stony loam, 25 to 60 percent slopes.
Montalto very stony loam, 25 to 35 percent slopes.
Montevallo very rocky silt loam, 25 to 65 percent slopes.

The soils of this unit are too steep and stony for agricultural use, and, generally, removing the stones does not pay. The areas should be kept in trees, and areas that are open ought to be planted to trees or shrubs. Logging is difficult in places on these soils. Selective cutting of the trees is probably the best method to maintain a continuous stands of productive trees and to maintain a good cover on the soils.

Capability unit VIIs–2

In this unit are poorly drained to very poorly drained, nearly level to gently sloping, stony soils on material from sandstone, gneiss, and shale. These soils are at the bases of slopes and in depressions. They are strongly acid and are low in natural fertility. Because of the high water table and seepage from higher areas, the soils are saturated most of the time. The following soils are in this unit:

Andover very stony sandy loam, 0 to 8 percent slopes.
Croton very stony loam, 0 to 8 percent slopes.
Woodglen very stony silt loam, 0 to 8 percent slopes.

The soils of this unit are fairly well suited to trees, but they are less productive than well-drained soils. They are wet in spring, and, as a result, it is difficult to move equipment and logs over them. Trees should be cut selectively, and cuttings ought to be made to improve the stands. Small areas can be planted to trees and shrubs to provide food and cover for wildlife. The district forester should be consulted to help develop a plan for managing the areas for trees.

Capability unit VIIIs–1

This unit consists of extremely stony land types and of gravel pits and slate dumps. The areas are not suitable for the commercial production of crops, grasses, or woody plants. Most of the acreage consists of steep talus slopes and of rock outcrops and gravel bars along the large streams. The following land types are in this unit:

Extremely stony land.
Riverwash.

These land types are too stony for adequate crops of timber or are likely to be flooded. The best use of the areas is probably for watershed protection and recreation. The vegetation should be managed to produce an occasional harvest of trees, to provide food and cover for wildlife, to prevent erosion, and for its esthetic value.

Productivity Ratings of the Soils

Table 1 shows estimated productivity ratings for representative field crops grown in the county. It also gives suitability ratings for certain specialized crops, fruit trees, and permanent pasture.

Each productivity rating indicates the estimated productivity of the soil for a particular crop in relation to a standard index of 100. The standard index represents the average acre yield obtained on the most productive soils in the county. The average acre yield represented by the standard index is given at the head of the column for each crop. The average yield figures are based on the yield of the crop during an average growing season when rainfall has been adequate and other climatic conditions have been normal.

The productivity ratings are given for two levels of management. In columns A are ratings to be expected under the prevailing management. These ratings are

TABLE 1.—*Estimated productivity ratings for*

[Productivity indexes in columns A are for common management; ratings in columns B are for improved

Soil	Corn (100=90 bu. per acre)		Wheat (100=40 bu. per acre)		Potatoes (100=450 bu. per acre)	
	A	B	A	B	A	B
Atkins silt loam		65				
Atkins silt loam, local alluvium, 0 to 3 percent slopes		60				
Bedford silt loam, 0 to 3 percent slopes	75	120	55	75		
Bedford silt loam, 3 to 8 percent slopes	75	115	50	70		
Bedford silt loam, 3 to 8 percent slopes, moderately eroded	70	110	45	65		
Bedford and Lawrence silt loams, 0 to 3 percent slopes	65	100	55	75		
Bedford and Lawrence silt loams, 3 to 8 percent slopes	65	95	50	70		
Brandywine loam, 3 to 8 percent slopes, moderately eroded	60	70	70	90		
Brandywine loam, 8 to 15 percent slopes, moderately eroded	55	70	65	80		
Brandywine loam, 8 to 15 percent slopes, severely eroded	55	65	50	70		
Brandywine loam, 15 to 25 percent slopes, moderately eroded			45	75		
Brandywine loam, 25 to 35 percent slopes, severely eroded						
Buchanan gravelly loam, 3 to 8 percent slopes	65	95	55	75		
Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded	60	90	50	70		
Buchanan very stony loam, 0 to 8 percent slopes						
Buchanan very stony loam, 8 to 25 percent slopes						
Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded.	95	125	90	125	100	135
Chester gravelly silt loam, 3 to 8 percent slopes	85	125	83	120	95	125
Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded.	80	120	75	115	85	120
Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded	75	110	70	105	70	90
Chester gravelly silt loam, 8 to 15 percent slopes	80	110	80	105	70	90
Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded.	80	105	70	105	70	85
Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded	75	100	65	100	60	80
Chester gravelly silt loam, 15 to 25 percent slopes			70	100		
Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded.			65	95		
Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded						
Chester gravelly silt loam, 25 to 35 percent slopes						
Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded.						
Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded						
Chester very stony silt loam, 0 to 8 percent slopes						
Chester very stony silt loam, 8 to 25 percent slopes						
Comly silt loam, 0 to 3 percent slopes	65	75	40	60		
Comly silt loam, 3 to 8 percent slopes	60	90	45	65		
Comly silt loam, 3 to 8 percent slopes, moderately eroded	55	90	40	55		
Comly silt loam, 8 to 15 percent slopes, moderately eroded	50	80	45	65		
Croton silt loam, 0 to 3 percent slopes		65				
Croton silt loam, 3 to 8 percent slopes		65				
Croton very stony loam, 0 to 8 percent slopes						
Duffield silt loam, 0 to 3 percent slopes, moderately eroded	100	135	100	125	80	135
Duffield silt loam, 3 to 8 percent slopes, moderately eroded	95	130	90	115	70	125
Duffield silt loam, 8 to 15 percent slopes, moderately eroded	90	130	85	105	70	125

See footnote at end of table.

based on records of yields obtained during an average growing season and under management presently practiced by most of the farmers in the county. In columns B are ratings that indicate yields that may be obtained in an average season when improved management is used.

An index of 50 indicates that the soil is only half as productive for the specified crop as a soil with a standard index of 100. By fertilizing heavily or by using other intensive management, an index of more than 100 can be obtained for the better soils. Duffield silt loam, 0 to 3 percent slopes, moderately eroded, for example, has a rating of 100 for most crops listed. Consequently, under the prevailing level of management, the farmer can expect to obtain average yields per acre of 90 bushels of corn, 40 bushels of wheat, and 4.0 tons of alfalfa. Under improved management this soil has an estimated productivity rating of 135 for corn, 125 for wheat, and 120 for alfalfa. This means that yields per acre under improved management would equal 121 bushels of corn or 50 bushels of wheat, grown for grain, and 4.8 tons of alfalfa. No ratings are given in table 1 for soils that are not suited to a particular crop or for soils where yields would be very low.

The estimates are based largely on interviews with farmers and on observations of representatives of the Soil Conservation Service, the Extension Service, and other agricultural workers who have had experience with the soils and crops of the county.

specified crops under two levels of management [1]

management. Dashes indicate the crop specified is not commonly grown or the soil is not suited to it]

Hay				Pasture of bluegrass (100=2.4 tons per acre)		Apples [1]		Peaches [1]	
Alfalfa (100=4.0 tons per acre)		Red clover and timothy mixture (100=3.0 tons per acre)							
A	B	A	B	A	B	A	B	A	B
		60	100	75	110				
				65	115				
60	100	60	85	90	125				
55	100	55	80	85	121				
50	95	50	75	80	115				
		60	95	90	125				
		55	85	85	120				
65	95	60	75	65	90	Fair	Good	Fair	Good.
60	80	55	65	60	85	Poor	Fair	Poor	Fair.
50	70	45	60	40	65	Poor	Fair	Poor	Fair.
50	75	55	60	45	70	Poor	Fair		
				40	65				
		80	90	80	115				
		75	85	70	105				
				75	85				
				65	80				
100	120	100	110	95	120	Fair	Good	Fair	Good.
95	115	90	110	75	115	Fair	Good	Fair	Good.
90	105	70	105	55	105	Fair	Good	Fair	Good.
80	95	55	100	50	100	Fair	Good	Fair	Good.
80	100	60	120	65	110	Fair	Good	Fair	Good.
75	95	55	100	60	105	Fair	Good	Fair	Good.
65	85	45	95	50	90	Fair	Good	Fair	Good.
65	80	40	90	45	85	Fair	Good		
60	75	40	85	40	75	Fair	Good		
				35	65				
				40	75				
				35	65				
				60	90				
				50	85				
		60	95	80	100				
		60	90	75	95				
		60	85	65	85				
		50	70	55	75				
		55	90	70	90				
		45	85	65	95				
				65	75				
100	120	80	110	63	115	Good	Excellent	Good	Excellent.
75	115	60	105	60	110	Good	Excellent	Good	Excellent.
70	110	55	100	55	100	Good	Excellent	Good	Excellent.

TABLE 1.—*Estimated productivity ratings for specified*

Soil	Corn (100=90 bu. per acre)		Wheat (100=40 bu. per acre)		Potatoes (100=450 bu. per acre)	
	A	B	A	B	A	B
Duffield silt loam, 15 to 25 percent slopes, moderately eroded	84	123	82	100	67	120
Duffield silt loam, 15 to 25 percent slopes, severely eroded						
Duffield silt loam, 25 to 35 percent slopes, moderately eroded						
Duffield silt loam, low clay variant, 0 to 3 percent slopes	100	135	100	125	80	135
Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded.	95	135	95	120	80	135
Duffield silt loam, low clay variant, 3 to 8 percent slopes	90	130	90	120	75	130
Duffield silt loam, low clay variant, 3 to 8 percent, moderately eroded.	85	125	90	115	70	125
Elk silt loam, 0 to 3 percent slopes	100	135	100	125	80	135
Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded	65	95	55	75	65	110
Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded.	65	90	50	70	65	110
Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded	60	90	45	65	60	105
Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded.			45	65		
Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded						
Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded.						
Glenville silt loam, 0 to 3 percent slopes	65	120	40	60		
Glenville silt loam, 0 to 3 percent slopes, moderately eroded	60	115	40	50		
Glenville silt loam, 3 to 8 percent slopes	60	115	45	65		
Glenville silt loam, 3 to 8 percent slopes, moderately eroded	60	110	40	55		
Glenville silt loam, 8 to 15 percent slopes	55	110	50	70		
Glenville silt loam, 8 to 15 percent slopes, moderately eroded	50	105	45	65		
Huntington silt loam	95	135	75	105		
Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded.	60	80	55	75	65	105
Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded.	60	80	45	70	60	105
Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded.						
Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded	75	105	70	105	70	85
Laidig very stony loam, 0 to 8 percent slopes						
Laidig very stony loam, 8 to 25 percent slopes						
Lindside silt loam	65	135	40	55		
Melvin silt loam		70				
Melvin silt loam, local alluvium, 0 to 3 percent slopes		70				
Melvin silt loam, local alluvium, 3 to 8 percent slopes		70				
Monongahela silt loam, 0 to 3 percent slopes	65	100	55	75		
Monongahela silt loam, 3 to 8 percent slopes, moderately eroded	65	95	50	70		
Montalto silt loam, 3 to 8 percent slopes, moderately eroded	80	120	75	110	85	115
Montalto silt loam, 8 to 15 percent slopes, moderately eroded	75	115	65	100	80	110
Montalto silt loam, 8 to 15 percent slopes, severely eroded			55	95		
Montalto silt loam, 15 to 25 percent slopes, moderately eroded			55	95		
Montalto silt loam, 15 to 25 percent slopes, severely eroded						
Montalto very stony loam, 0 to 8 percent slopes						
Montalto very stony loam, 8 to 25 percent slopes						
Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded.	55	70	50	70	40	95
Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded.	55	65	45	65	55	95
Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded.			40	50		
Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded.			40	55		
Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded.						
Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded	85	125	65	105	75	120
Murrill gravelly loam 8 to 15 percent slopes, moderately eroded	80	120	50	95	70	120
Murrill gravelly loam, 8 to 15 percent slopes, severely eroded			45	85		
Murrill very stony loam, 0 to 8 percent slopes						
Murrill very stony loam, 8 to 25 percent slopes						
Norton silt loam, 0 to 3 percent slopes	85	130	90	125	95	135
Norton silt loam, 3 to 8 percent slopes, moderately eroded	85	125	75	110	90	125
Norton silt loam, 8 to 15 percent slopes, moderately eroded	80	120	60	95	85	120

See footnote at end of table.

crops under two levels of management [1]—Continued

Hay				Pasture of bluegrass (100=2.4 tons per acre)		Apples [1]		Peaches [1]	
Alfalfa (100=4.0 tons per acre)		Red clover and timothy mixture (100=3.0 tons per acre)							
A	B	A	B	A	B	A	B	A	B
61	104	49	93	50	88	Fair	Good		
50	95	45	90	40	65				
				41	75				
90	120	80	110	65	115	Good	Excellent	Good	Excellent.
85	115	70	110	50	110	Good	Excellent	Good	Excellent.
75	115	65	105	55	110	Good	Excellent	Good	Excellent.
75	110	60	100	50	105	Good	Excellent	Good	Excellent.
75	120	65	110	65	115	Good	Excellent	Good	Excellent.
60	95	50	90	50	100	Fair	Good	Fair	Good.
55	85	45	85	45	90	Fair	Good	Fair	Good.
50	75	40	80	40	80	Fair	Good		
50	80	40	80	40	85	Fair	Good		
				34	71				
				34	75				
		65	95	85	115				
		60	90	75	105				
		60	85	70	95				
		55	80	40	85				
		55	75	40	85				
		50	70	55	95				
		100	110	100	125				
55	85	45	80	50	90	Fair	Good	Fair	Good.
50	80	40	80	40	85	Fair	Good	Fair	Good.
				30	75				
65	95	55	98	60	105	Fair	Good	Fair	Good.
				50	90				
				40	85				
		60	95	90	125				
		55	90	75	115				
		55	90	75	115				
		65	90	80	115				
		60	100	90	125				
		55	90	85	115				
70	100	60	100	55	100	Fair	Good	Fair	Good.
65	90	50	95	40	85	Fair	Good	Fair	Good.
50	80	45	90	40	75	Fair	Good		
50	80	45	90	40	75	Fair	Good		
				35	65				
				50	90				
				40	90				
65	80	50	75	40	70	Poor	Fair	Poor	Fair.
50	65	50	65	40	65	Poor	Fair	Poor	Fair.
50	55	60	55	30	50				
55	60	20	60	35	55	Poor	Fair		
				20	40				
80	100	55	100	60	90	Good	Excellent	Good	Excellent.
60	95	400	90	25	75	Good	Excellent	Good	Excellent.
50	85	35	85	20	65	Fair	Good	Fair	Good.
				60	90				
				45	75				
100	120	100	110	95	120	Fair	Good	Fair	Good.
75	105	80	100	85	105	Fair	Good	Fair	Good.
70	95	70	95	70	90	Fair	Good	Fair	Good.

TABLE 1.—*Estimated productivity ratings for specified*

Soil	Corn (100=90 bu. per acre)		Wheat (100=40 bu. per acre)		Potatoes (100=450 bu. per acre)	
	A	B	A	B	A	B
Norton silt loam, 15 to 25 percent slopes, moderately eroded			55	90		
Penn shaly silt loam, 3 to 8 percent slopes	65	100	75	95		
Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded	65	100	70	90		
Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded	60	95	65	80		
Penn shaly silt loam, 8 to 15 percent slopes, severely eroded			55	75		
Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded			50	70		
Penn shaly silt loam, 15 to 25 percent slopes, severely eroded						
Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded						
Philo silt loam	65	95	40	60		
Readington silt loam, 0 to 3 percent slopes	65	95	50	70		
Readington silt loam, 3 to 8 percent slopes	60	90	45	65		
Readington silt loam, 3 to 8 percent slopes, moderately eroded	60	90	45	65		
Readington silt loam, 8 to 15 percent slopes, moderately eroded	60	85	40	55		
Ryder silt loam, 0 to 3 percent slopes	85	125	80	125	80	135
Ryder silt loam, 3 to 8 percent slopes, moderately eroded	80	115	65	105	75	120
Ryder silt loam, 8 to 15 percent slopes, moderately eroded	70	105	50	95	70	120
Ryder silt loam, 8 to 15 percent slopes, severely eroded			40	85		
Ryder silt loam, 15 to 25 percent slopes, severely eroded						
Shelmadine silt loam, 0 to 3 percent slopes		60				
Shelmadine silt loam, 3 to 8 percent slopes		60				
Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded		55				
Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded						
Trexler shaly silt loam, 0 to 3 percent slopes	85	110	85	120	85	125
Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded	80	105	75	115	80	120
Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded	75	105	70	105	75	115
Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded	75	105	70	105	75	115
Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded			65	95		
Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded			65	95		
Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded			65	95		
Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded.	70	100	60	80	70	110
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded.	65	95	55	75	65	110
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded.	65	90	50	70	65	105
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded.	65	90	55	70	65	110
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded.	60	90	50	65	65	110
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded.			40	55		
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded.						
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded.						
Washington silt loam, 0 to 3 percent slopes	100	135	80	125	80	135
Washington silt loam, 0 to 3 percent slopes, moderately eroded	95	130	75	120	75	130
Washington silt loam, 3 to 8 percent slopes	90	130	70	115	75	125
Washington silt loam, 3 to 8 percent slopes, moderately eroded	85	125	65	105	75	120
Washington silt loam, 8 to 15 percent slopes	85	125	55	100	75	120
Washington silt loam, 8 to 15 percent slopes, moderately eroded	80	120	50	95	70	120
Washington silt loam, 8 to 15 percent slopes, severely eroded			45	85		
Washington silt loam, 15 to 25 percent slopes, moderately eroded			40	75		
Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded.	85	125	65	100	75	120
Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded.	80	120	50	95	70	120
Wheeling gravelly loam, 0 to 3 percent slopes	85	110	80	120	85	125
Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded	80	105	75	115	80	120
Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded	80	105	70	105	75	115
Woodglen silt loam, 0 to 3 percent slopes						
Woodglen silt loam, 3 to 8 percent slopes						
Worsham silt loam, 0 to 3 percent slopes						
Worsham silt loam, 0 to 3 percent slopes, moderately eroded						
Worsham silt loam, 3 to 8 percent slopes						
Worsham silt loam, 3 to 8 percent slopes, moderately eroded						

[1] The rating indicates relative suitability of the soil for this crop and is not the standard yield.

crops under two levels of management [1]—Continued

Hay				Pasture of bluegrass (100=2.4 tons per acre)		Apples [1]		Peaches [1]	
Alfalfa (100=4.0 tons per acre)		Red clover and timothy mixture (100=3.0 tons per acre)							
A	B	A	B	A	B	A	B	A	B
60	85	65	90	65	85	Fair	Good	Fair	Good.
75	95	60	85	65	90	Fair	Good	Fair	Good.
65	85	55	80	60	75	Poor	Fair	Poor	Fair
60	90	50	75	50	75	Poor	Fair	Poor	Fair.
55	75	45	70	40	65				
45	65	40	65	35	55				
				25	40				
				15	35				
		50	85	90	125				
		55	95	85	125				
		50	90	75	115				
		45	85	65	105				
		40	80	55	90				
75	120	65	110	65	115	Good	Excellent	Good	Excellent.
65	105	50	100	40	90	Good	Excellent	Good	Excellent.
50	95	40	90	25	75	Good	Excellent	Good	Excellent.
40	85	35	85	20	65	Fair	Good		
				15	55	Poor	Fair		
		60	95	65	115				
		55	90	55	105				
		45	80	40	90				
		40	80	35	85				
80	105	60	105	55	115	Fair	Excellent	Fair	Excellent.
70	100	55	100	50	105	Fair	Excellent	Fair	Excellent.
60	95	50	95	40	90	Fair	Excellent	Fair	Excellent.
60	95	50	95	40	90	Fair	Excellent	Fair	Excellent.
50	85	40	90	30	80	Fair	Good		
50	85	40	90	30	80	Fair	Good		
50	85	40	90	30	80	Fair	Good		
65	100	55	100	60	105	Fair	Good	Fair	Good.
60	95	50	90	60	100	Fair	Good	Fair	Good.
50	80	45	80	40	85	Fair	Good	Fair	Good.
60	85	45	85	45	90	Fair	Good	Fair	Good.
50	80	40	80	40	85	Poor	Fair	Poor	Fair.
45	75	35	70	30	75	Fair	Good		
				20	65	Poor	Fair	Poor	Fair.
				20	65				
100	120	90	110	65	115	Good	Excellent	Good	Excellent.
100	115	80	105	50	105	Good	Excellent	Good	Excellent.
95	105	85	105	40	95	Good	Excellent	Good	Excellent.
90	105	80	100	40	90	Good	Excellent	Good	Excellent.
85	100	75	95	30	85	Good	Excellent	Good	Excellent.
80	95	70	90	25	75	Good	Excellent	Good	Excellent.
70	90	60	85	20	65	Fair	Good	Fair	Good.
60	90	50	80	20	60	Fair	Good	Fair	Good.
50	105	50	100	35	90	Good	Excellent	Good	Excellent.
35	95	40	90	25	75	Good	Excellent	Good	Excellent.
75	105	70	105	55	116	Fair	Excellent	Fair	Excellent.
60	100	60	100	50	105	Fair	Excellent	Fair	Excellent.
55	95	50	95	40	90	Fair	Excellent	Fair	Excellent.
				65	100				
				70	110				
		60	95	65	105				
		50	90	55	95				
		55	95	65	110				
		45	80	55	95				

Woodland Uses of the Soils [1]

Lehigh County originally had a dense cover of trees, but clearing for farms and cutting for commercial purposes eliminated the virgin stands of timber. Now, the woodlands consist of second- and third-growth stands. Because of the intensive development of the area for agriculture, less than 25 percent of the woodland is classified as commercial (*15*). The principal forest types that make up the present woodlands (*19*) and the proportionate extent of each follow:

	Percentage of total woodland in the county
Red oak ---------- Northern red oak predominates; associates are black oak, scarlet oak, chestnut oak, and yellow-poplar.	94
Sugar maple-beech-yellow birch ---------- Sugar maple, beech, and yellow birch are the component species; associates are varying admixtures of basswood, red maple, hemlock, northern red oak, white ash, white pine, black cherry, sweet birch, and American elm.	6

Saw timber makes up approximately 36 percent of the acreage in commercial forests. Seedlings, saplings, and poletimber account for the remainder.

In general, the soils in this county are capable of supporting a good growth of red oak, yellow-poplar, and white pine. At the present time, however, the stands in many wooded areas are made up predominantly of chestnut oak and red maple. Trees grow slowly on the shallow soils and on the deep, poorly drained soils.

A landowner can encourage the more desirable kinds of trees to grow in his woodlands by using good woodland management. The soils and the climate are favorable, and help in planning a program of woodland improvement can be obtained from local technicians. How much effort the landowner is willing to make toward improving his woodlands probably depends on general economic conditions and on the extent of urban development.

Studies have been made of the rate at which trees grow on five soils that are extensive in the county. The trees grew on 24 sample plots. The oak-site index obtained for each of the soils was based on the average height of a normal stand when the trees were 50 years of age.[2] Other soils in the county that have characteristics similar to those of the soils studied were assumed to have approximately the same rating. The volume of timber that normal stands will produce at different ages can be determined by using this index.

The soils on which trees and associated vegetation grow is the place from which to start in managing woodlands. To help in planning management for the soils of this county, soils that have similar characteristics have been placed in woodland groups. The soils have been grouped mainly according to similarity in depth, drainage, and parent material. Each woodland group is described in the pages that follow. Estimated ratings of woodland suitability groups for various factors important to woodland use and management are given in table 2. The estimates are based on Schnur's "Yield, Stand, and Volume Tables For Even-Aged Upland Oak Forests" (*13*).[3]

The kinds of trees that are suitable for planting on the soils of each woodland group are listed in table 2 in order of species priority. The names of native trees that should be encouraged are also given. In addition, suitable species to grow as Christmas trees are listed. Of the species listed that are suitable to grow as Christmas trees, the kind that is best to plant depends upon the market, which fluctuates according to the desires of buyers.

Seedling mortality refers to the expected degree of mortality, or loss of natural seedlings, as influenced by the soils or other factors in the environment. The ratings are assigned with the assumption that nursery stock of proper grade is properly planted. The ratings used to indicate the degree of seedling mortality are *slight*, *moderate*, and *severe*.

A rating of slight in the column showing seedling mortality means that the site presents no special problems and that losses would not exceed 25 percent of the planted stock. Normally, satisfactory restocking could be obtained by the first planting and natural regeneration would be adequate. A rating of moderate means that losses of 25 to 50 percent of the seedlings can be expected. Some replanting will be needed to fill in openings after the first planting, and natural regeneration is not always adequate or timely. A rating of severe means that planting losses amount to more than 50 percent of the stock planted; natural regeneration is not adequate; and a second or third planting may be needed. Also, the seedbed will require special preparation, and careful planting techniques will be needed.

Plant competition refers to the degree of competition that can be expected from brush, grass, and undesirable trees that invade the planting site.

Ratings in the column showing equipment limitations refer to the characteristics of the soils and topographic features that restrict or prohibit the use of equipment that is commonly used in harvesting trees or in cultivating or planting seedlings. Steepness of slope, surface stones and boulders, and prolonged wetness of the soil are the principal limitations that restrict the use of equipment on the soils of Lehigh County.

The hazard of erosion refers to the likelihood of erosion when the soils are managed according to currently acceptable practices designed to protect them. The hazard of windthrow refers to windfirmness as reflected by the characteristics of the soils that control the development of the root systems of trees.

Woodland group 1

In this group (see table 2) are deep and moderately deep, well-drained soils that are medium textured. These soils developed in acid material from schist, gneiss, sandstone, shale, slate, and conglomerate. They are on uplands and terraces and have slopes of as much as 8 percent. The following soils are in this group:

Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded.
Chester gravelly silt loam, 3 to 8 percent slopes.
Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded.
Chester very stony silt loam, 0 to 8 percent slopes.
Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded.
Fleetwood very stony loam, 0 to 8 percent slopes.
Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded.
Laidig very stony loam, 0 to 8 percent slopes.

[1] By VERNAL C. MILES, woodland specialist, Soil Conservation Service.

[2] Description and location of sample plots are on file in the State office of the Soil Conservation Service, Harrisburg, Pa.

[3] Italic numbers in parentheses refer to Literature Cited, p. 113.

Norton silt loam, 0 to 3 percent slopes.
Norton silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, 0 to 3 percent slopes.
Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Wheeling gravelly loam, 0 to 3 percent slopes.
Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded.

Most of these soils are excellent for timber, but the very stony Laidig, the Trexler soils, and the very stony Fleetwood soil, although good for timber, are less well suited than the other soils. Seedling mortality and equipment limitations are slight on most of the soils, but they are moderate on the very stony Chester, Laidig, and Fleetwood soils.

Woodland group 2

This group (see table 2) consists of deep and moderately deep, well-drained soils that are medium textured. The soils developed in limy material from limestone, diabase, and cement rock. They are on uplands, terraces, and flood plains and have slopes of as much as 8 percent. The following soils are in this group:

Duffield silt loam, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, 3 to 8 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 0 to 3 percent slopes.
Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 3 to 8 percent slopes.
Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded.
Elk silt loam, 0 to 3 percent slopes.
Huntington silt loam.
Montalto silt loam, 3 to 8 percent slopes, moderately eroded.
Montalto very stony loam, 0 to 8 percent slopes.
Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded.
Murrill very stony loam, 0 to 8 percent slopes.
Ryder silt loam, 0 to 3 percent slopes.
Ryder silt loam, 3 to 8 percent slopes, moderately eroded.
Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded.
Washington silt loam, 0 to 3 percent slopes.
Washington silt loam, 0 to 3 percent slopes, moderately eroded.
Washington silt loam, 3 to 8 percent slopes.
Washington silt loam, 3 to 8 percent slopes, moderately eroded.

Most of these soils are excellent for timber, but the Murrill soils and the very stony Montalto soil, although good for timber, are less well suited than the other soils. Also on the very stony Murrill and the Montalto soils, seedling mortality is moderate and equipment limitations are severe. The Huntington soil is on flood plains where it is flooded occasionally. The floodwaters recede in less than 18 hours.

Woodland group 3

In this group (see table 2) are moderately deep and deep, severely eroded, well-drained soils that are medium textured. The soils developed in acid material from shale, sandstone, schist, and gneiss. They are on uplands and have slopes of as much as 8 percent. The following soils are in this group:

Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded.
Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded.

There are only a few soils in this woodland group, and the statements in table 2 need no further interpretation here.

Woodland group 4

This group (see table 2) is made up of deep and moderately deep, well-drained soils that are medium textured. The soils developed in acid material from schist, gneiss, sandstone, shale, slate, and conglomerate. They are on uplands and terraces and have slopes of 8 to 25 percent. The following soils are in this group:

Chester gravelly silt loam, 8 to 15 percent slopes.
Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded.
Chester gravelly silt loam, 15 to 25 percent slopes.
Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded.
Chester very stony silt loam, 8 to 25 percent slopes.
Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded.
Fleetwood very stony loam, 8 to 25 percent slopes.
Laidig very stony loam, 8 to 25 percent slopes.
Norton silt loam, 8 to 15 percent slopes, moderately eroded.
Norton silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded.

Most of these soils are good for timber, but the Wheeling and nonstony Chester soils are excellent for timber, and the very stony Laidig soil is fair. Seedling mortality is moderate on the very stony soils, and equipment limitations are severe.

Woodland group 5

In this group (see table 2) are deep and moderately deep, well-drained soils that are medium textured. The soils developed in material from limestone diabase and from other material influenced by lime. They are on uplands and have slopes of 8 to 25 percent. The following soils are in this group:

Duffield silt loam, 8 to 15 percent slopes, moderately eroded.
Duffield silt loam, 15 to 25 percent slopes, moderately eroded.
Montalto silt loam, 8 to 15 percent slopes, moderately eroded.
Montalto silt loam, 15 to 25 percent slopes, moderately eroded.
Montalto very stony loam, 8 to 25 percent slopes.
Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded.
Murrill very stony loam, 8 to 25 percent slopes.
Ryder silt loam, 8 to 15 percent slopes, moderately eroded.
Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded.
Washington silt loam, 8 to 15 percent slopes.
Washington silt loam, 8 to 15 percent slopes, moderately eroded.
Washington silt loam, 15 to 25 percent slopes, moderately eroded.

Most of these soils are excellent for timber, but the very stony Montalto soil and the very stony Murrill soil, although good for timber, are less well suited than the others. Seedling mortality is moderate on the very stony soils, and equipment limitations are severe.

Woodland group 6

This group (see table 2) consists of moderately deep and deep, well-drained, severely eroded soils that are medium textured. These soils developed in acid and limy material from sandstone, slate, schist, gneiss, diabase, and

limestone. They are on uplands and have slopes of 8 to 25 percent. The following soils are in this group:

Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded.
Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded.
Duffield silt loam, 15 to 25 percent slopes, severely eroded.
Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded.
Montalto silt loam, 8 to 15 percent slopes, severely eroded.
Montalto silt loam, 15 to 25 percent slopes, severely eroded.
Murrill gravelly loam, 8 to 15 percent slopes, severely eroded.
Ryder silt loam, 8 to 15 percent slopes, severely eroded.
Ryder silt loam, 15 to 25 percent slopes, severely eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded.
Washington silt loam, 8 to 15 percent slopes, severely eroded.

TABLE 2.—*Estimated ratings*

[F–1 soils are excellent for timber; the site index for oaks on F–1 soils is 75 or better, and the expected yield is 13,750 board feet per acre. are fairly good for timber; the site index for oaks on F–3 soils is 55 to 64, and the expected yield is 6,300 board feet per acre. F–4 soils yields are for trees at 50 years of age]

Woodland group and mapping symbols	Potential soil productivity for oaks	Species priority for—
		Native trees
Group 1. Deep and moderately deep, well-drained soils on acid material; slopes of 0 to 8 percent (CgA2, CgB, CgB2, ChB, FgB2, FhB, LaB2, LdB, NtA, NtB2, TrA, TrB2, WhA, WhB2).	F–1	Yellow-poplar, white pine, red oak.
Group 2. Deep and moderately deep, well-drained soils on limy material; slopes of 0 to 8 percent (DuA2, DuB2, DvA, DvA2, DvB, DvB2, EkA, Hn, MmB2, MnB, MuB2, MvB, RyA, RyB2, WcB2, WgA, WgA2, WgB, WgB2).	F–1	Yellow-poplar, white pine, red oak.
Group 3. Moderately deep and deep, severely eroded, well-drained soils on acid material; slopes of 3 to 8 percent (CgB3, TrB3).	F–2	Yellow-poplar, white pine, red oak.
Group 4. Deep and moderately deep well-drained soils on acid material; slopes of 8 to 25 percent (CgC, CgC2, CgD, CgD2, ChD, FgC2, FgD2, FhD, LdD, NtC2, NtD2, TrC2, TrD2, WhC2).	F–2	Yellow-poplar, white pine, red oak.
Group 5. Deep and moderately deep, well-drained soils on limy material; slopes of 8 to 25 percent (DuC2, DuD2, MmC2, MmD2, MnD, MuC2, MvD, RyC2, WcC2, WgC, WgC2, WgD2).	F–1	Yellow-poplar, white pine, red oak.
Group 6. Moderately deep and deep, well-drained, severely eroded soils on acid and limy material; slopes of 8 to 25 percent (CgC3, CgD3, DuD3, FgC3, FgD3, MmC3, MmD3, MuC3, RyC3, RyD3, TrC3, TrD3, WgC3).	F–2	Yellow-poplar, white pine, red oak.
Group 7. Deep and moderately deep, well-drained soils on acid and limy material; slopes of more than 25 percent (CgE, CgE2, ChF, DuE2, DuF2, FgE2, FhF, MnE).	F–2	Yellow-poplar, white pine, red oak.
Group 8. Deep and moderately deep, well-drained, severely eroded soils on acid and limy material; slopes of more than 25 percent (CgE3, MmE3, RyE3).	F–2	Yellow-poplar, white pine, red oak.
Group 9. Deep, moderately well drained to somewhat poorly drained soils on limy and acid material; slopes of 0 to 8 percent (BdA, BdB, BdB2, BeA, BeB, BgB, BgB2, BhB, CmA, CmB, CmB2, GnA, GnA2, GnB, GnB2, Ln, MlA, MlB2, Ph, RdA, RdB, RdB2).	F–2	Yellow-poplar, white pine, red oak.
Group 10. Deep, moderately well drained soils on acid material; slopes of 8 to 25 percent (BhD, CmC2, GnC, GnC2, RdC2).	F–2	Yellow-poplar, white pine, red oak.
Group 11. Deep, poorly drained soils on acid and limy material; slopes of 0 to 8 percent (AvB, Aw, AxA, CrA, CrB, CsB, Mh, MkA, MkB, ShA, ShB, ShB2, ShC2, WoA, WoB, WrB, WsA, WsA2, WsB, WsB2).	F–4	White pine, hemlock, pin oak, red maple.
Group 12. Shallow to moderately deep, well-drained soils on acid material; slopes of 0 to 8 percent (BfB2, KnB2, MoB2, PeB, PeB2, TsA2, TsB2, TsB3).	F–3	White pine, red oak, black oak.
Group 13. Shallow, well-drained soils on acid material; slopes of 8 to 25 percent (BfC2, BfD2, KnC2, MoC2, MoD2, MsD, PeC2, PeD2, TsC2, TsD2).	F–3	White pine, red oak, black oak.
Group 14. Shallow to very shallow, well-drained, severely eroded soils on acid material; slopes of 8 to 25 percent (BfC3, BfD3, KnD3, MoC3, MoD3, PeC3, PeD3, TsC3, TsD3).	F–4	White pine, red oak, black oak.
Group 15. Shallow to very shallow, well-drained soils on acid material; slopes of 25 to 65 percent (BfE3, KnE3, MoE2, MoE3, MoF2, MoF3, MsF, PeE2, PeE3, TsE2, TsE3).	F–4	White pine, red oak, black oak.

[1] Extremely stony land and Riverwash are not suitable for growing timber and are not rated in this table. Also, the units of Made land are not rated, because, although trees grow on them, the soil material varies from place to place and the limitations and productivity are difficult to predict.

Most of these soils are good for timber, but the Trexler soils are only fair for that purpose. The Chester, Fleetwood, and Trexler soils are suited to larch and to Norway spruce, as well as to white pine and Austrian pine.

Woodland group 7

In this group (see table 2) are deep and moderately deep, well-drained soils that are medium textured. The soils developed in acid and limy material from slate, sandstone, schist, gneiss, conglomerate, diabase, and limestone. They are on uplands and have slopes of more than 25 percent. The following soils are in this group:

Chester gravelly silt loam, 25 to 35 percent slopes.
Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded.
Chester very stony silt loam, 25 to 50 percent slopes.
Duffield silt loam, 25 to 35 percent slopes, moderately eroded.
Duffield silt loam, 35 to 55 percent slopes, moderately eroded.

of woodland groups of soils [1]

F–2 soils are good for timber; the site index for oaks on F–2 soils is 65 to 74, and the expected yield is 9,750 board feet per acre. F–3 soils are poor for timber; the site index for oaks on F–4 soils is 54 or less, and the expected yield is less than 3,250 board feet per acre. Expected

Species priority for—Continued		Seedling mortality	Plant competition	Equipment limitations	Hazard of—	
Planted trees	Christmas trees				Erosion	Windthrow
White pine, larch, Austrian pine, Norway spruce.	Norway spruce, Scotch pine, white pine, Douglas-fir.	Slight or moderate.	Severe	Slight or moderate.	Slight	Slight.
White pine, Austrian pine.	Norway spruce, Scotch pine, white pine, Douglas-fir.	Slight	Severe	Slight	Slight	Slight.
White pine, larch, Norway spruce, Austrian pine.	Norway spruce, Scotch pine, white pine, Douglas-fir.	Moderate	Moderate	Slight	Slight	Slight.
White pine, larch, Norway spruce.	Scotch pine, white pine, Norway spruce, Douglas-fir.	Slight	Severe	Moderate	Moderate	Slight.
White pine, Austrian pine.	Scotch pine, white pine, Norway spruce, Douglas-fir.	Slight	Severe	Moderate	Moderate	Slight.
White pine, Austrian pine.	Scotch pine, white pine, Norway spruce, Douglas-fir.	Moderate	Moderate	Moderate	Moderate	Slight.
White pine, larch, Norway spruce, Austrian pine.	Generally not suited	Slight	Severe	Severe	Severe	Slight.
White pine, larch, Norway spruce, Austrian pine.	Generally not suited	Moderate	Moderate	Severe	Severe	Slight.
White pine, larch, Norway spruce, Austrian pine.	Scotch pine, white pine, white spruce, Norway spruce.	Slight	Severe	Moderate	Slight	Slight.
White pine, larch, Norway spruce, Austrian pine.	Scotch pine, white pine, Norway spruce, white spruce.	Slight	Severe	Severe	Moderate	Slight.
White pine, hemlock, white spruce.	Generally not suited	Severe	Moderate	Severe	Slight	Severe.
White pine, Virginia pine.	Scotch pine, Austrian pine	Moderate	Moderate	Slight	Slight	Moderate.
White pine, Virginia pine.	Scotch pine, Austrian pine	Moderate	Moderate	Moderate	Moderate	Moderate.
White pine, Virginia pine.	Scotch pine, Austrian pine	Moderate	Moderate	Moderate	Severe	Moderate.
White pine, Virginia pine.	Not practical	Severe	Slight	Severe	Severe	Severe.

Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded.
Fleetwood very stony loam, 25 to 60 percent slopes.
Montalto very stony loam, 25 to 35 percent slopes.

Seedling mortality is slight on most of these soils, but on the very stony Chester and Montalto soils it is moderate. The Duffield and Montalto soils are best suited to white pine and Austrian pine.

Woodland group 8

This group (see table 2) consists of deep and moderately deep, well-drained, severely eroded soils that are medium textured. The soils developed in acid and limy material from schist, gneiss, diabase, and limestone. They are on uplands and have slopes of more than 25 percent. The following soils are in this group:

Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded.
Montalto silt loam, 25 to 35 percent slopes, severely eroded.
Ryder silt loam, 25 to 35 percent slopes, severely eroded.

Although these soils are generally good for timber, the Montalto and Ryder soils are best suited to white pine and Austrian pine.

Woodland group 9

This group (see table 2) consists of deep, moderately well drained to somewhat poorly drained soils that are medium textured. These soils developed in limy and acid material from schist, gneiss, sandstone, shale, conglomerate, diabase, and limestone. They are on uplands, terraces, and flood plains and have slopes of as much as 8 percent. The following soils are in this group:

Bedford silt loam, 0 to 3 percent slopes.
Bedford silt loam, 3 to 8 percent slopes.
Bedford silt loam, 3 to 8 percent slopes, moderately eroded.
Bedford and Lawrence silt loams, 0 to 3 percent slopes.
Bedford and Lawrence silt loams, 3 to 8 percent slopes.
Buchanan gravelly loam, 3 to 8 percent slopes.
Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded.
Buchanan very stony loam, 0 to 8 percent slopes.
Comly silt loam, 0 to 3 percent slopes.
Comly silt loam, 3 to 8 percent slopes.
Comly silt loam, 3 to 8 percent slopes, moderately eroded.
Glenville silt loam, 0 to 3 percent slopes.
Glenville silt loam, 0 to 3 percent slopes, moderately eroded.
Glenville silt loam, 3 to 8 percent slopes.
Glenville silt loam, 3 to 8 percent slopes, moderately eroded.
Lindside silt loam.
Monongahela silt loam, 0 to 3 percent slopes.
Monongahela silt loam, 3 to 8 percent slopes, moderately eroded.
Philo silt loam.
Readington silt loam, 0 to 3 percent slopes.
Readington silt loam, 3 to 8 percent slopes.
Readington silt loam, 3 to 8 percent slopes, moderately eroded.

These soils are good for trees, but the Bedford and Lawrence silt loams and the Lindside soil are best suited to white pine and Austrian pine. Equipment limitations are moderate on most of the soils, but they are severe on the very stony Buchanan soil and slight on the Bedford, Lawrence, and Lindside soils. The Lindside and Philo soils are on flood plains where they are flooded occasionally. The floodwaters recede in less than 18 hours.

Woodland group 10

In this group (see table 2) are deep, moderately well drained soils that are medium textured. The soils developed in acid material from schist, gneiss, sandstone, shale, and conglomerate. They have slopes of 8 to 25 percent. The following soils are in this group:

Buchanan very stony loam, 8 to 25 percent slopes.
Comly silt loam, 8 to 15 percent slopes, moderately eroded.
Glenville silt loam, 8 to 15 percent slopes.
Glenville silt loam, 8 to 15 percent slopes, moderately eroded.
Readington silt loam, 8 to 15 percent slopes, moderately eroded.

There are only a few soils in this woodland group, and the statements in table 2 need no further interpretation here.

Woodland group 11

In this group (see table 2) are deep, poorly drained soils that are medium textured. These soils developed in acid and limy material from schist, gneiss, sandstone, slate, shale, diabase, and limestone. They are on uplands and flood plains, and some have slopes of 8 percent or more. The following soils are in this group:

Andover very stony sandy loam, 0 to 8 percent slopes.
Atkins silt loam.
Atkins silt loam, local alluvium, 0 to 3 percent slopes.
Croton silt loam, 0 to 3 percent slopes.
Croton silt loam, 3 to 8 percent slopes.
Croton very stony loam, 0 to 8 percent slopes.
Melvin silt loam.
Melvin silt loam, local alluvium, 0 to 3 percent slopes.
Melvin silt loam, local alluvium, 3 to 8 percent slopes.
Shelmadine silt loam, 0 to 3 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded.
Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded.
Woodglen silt loam, 0 to 3 percent slopes.
Woodglen silt loam, 3 to 8 percent slopes.
Woodglen very stony silt loam, 0 to 8 percent slopes.
Worsham silt loam, 0 to 3 percent slopes.
Worsham silt loam, 0 to 3 percent slopes, moderately eroded.
Worsham silt loam, 3 to 8 percent slopes.
Worsham silt loam, 3 to 8 percent slopes, moderately eroded.

On most of these soils the hazard of erosion is slight, but on Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded, it is moderate. Atkins silt loam and Melvin silt loam are on flood plains where they are flooded occasionally. The floodwaters recede in less than 18 hours, except for some areas that are ponded.

Woodland group 12

In this group (see table 2) are shallow to moderately deep, well-drained soils that are medium textured. These soils developed in acid material from schist, gneiss, shale, and sandstone. They are on uplands and have slopes of as much as 8 percent. The following soils are in this group:

Brandywine loam, 3 to 8 percent slopes, moderately eroded.
Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded.
Penn shaly silt loam, 3 to 8 percent slopes.
Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded.

Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded.

Most of these soils are fairly good for timber, but the Montevallo soil and the severely eroded Trexler soil are poor for that purpose. On the severely eroded Trexler soil, the hazard of further erosion is moderate.

Woodland group 13

This group (see table 2) consists of shallow, well-drained soils that are medium textured. The soils developed in acid material from schist, gneiss, sandstone, and shale. They are on uplands and have slopes of 8 to 25 percent. The following soils are in this group:

Brandywine loam, 8 to 15 percent slopes, moderately eroded.
Brandywine loam, 15 to 25 percent slopes, moderately eroded.
Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded.
Montevallo very rocky silt loam, 8 to 25 percent slopes.
Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded.

Most of these soils are fairly good for timber, but the Montevallo soils are poor for that purpose. Seedling mortality is severe on the very rocky Montevallo soil, and plant competition is slight.

Woodland group 14

In this group (see table 2) are shallow to very shallow, well-drained, severely eroded soils that are medium textured. These soils developed in acid material from schist, gneiss, sandstone, and shale. They are on uplands and have slopes of 8 to 25 percent. The following soils are in this group:

Brandywine loam, 8 to 15 percent slopes, severely eroded.
Brandywine loam, 15 to 25 percent slopes, severely eroded.
Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded.
Penn shaly silt loam, 8 to 15 percent slopes, severely eroded.
Penn shaly silt loam, 15 to 25 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded.

Seedling mortality is severe on the Montevallo soils, and plant competition is slight. On the Trexler soils the hazard of further erosion is moderate.

Woodland group 15

This group (see table 2) is made up of shallow to very shallow, well-drained soils that are medium textured. The soils developed in acid material from slate, shale, and sandstone. They are on uplands and have slopes of 25 to 65 percent. The following soils are in this group:

Brandywine loam, 25 to 35 percent slopes, severely eroded.
Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded.
Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded.
Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded.
Montevallo very rocky silt loam, 25 to 65 percent slopes.
Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded.
Penn shaly silt loam, 25 to 40 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded.

Most of these soils are poor for timber, but the moderately eroded Penn soil is fairly good for that purpose.

Suitability of the Soils for Wildlife

In this section the potential of the soils of Lehigh County as habitats for wildlife is discussed. The principal species of game in the county are the ring-necked pheasant, bobwhite, mourning dove, cottontail rabbit, gray squirrel, white-tailed deer, and various kinds of waterfowl. There are also many kinds of songbirds and other birds that eat insects. In addition, small animals and other nongame species frequent the area. These have great value for the pleasure they give to persons who live in the country. They also have significant, but obscure, biological functions that make them important. Furthermore, they eat large quantities of undesirable insects and pests that destroy farm crops.

The occurrence and abundance of some kinds of wildlife are related to the kinds of soils. Many of the relationships are indirect and are influenced primarily by land use, the kinds of plants, and topography. Wildlife is generally more abundant, the individual animals tend to be larger, and the rate of production is higher on the fertile soils than on soils of poor quality. On some farms the wildlife population has been reduced because the food supplies and protective cover were destroyed. If there is a suitable cover of plants, wildlife can be encouraged to live in an area, and the vegetation will also help protect the soils.

Among the areas that are suitable for wildlife are parks, wildlife refuges, private and leased shooting preserves, and private and public fishing ponds. The landowner can obtain information from the Pennsylvania Game Commission (*14*) about trees, shrubs, vines, and field crops that will help to encourage wildlife. Local soil conservationists and wildlife technicians will also help determine the most beneficial practices to use to establish wildlife on a particular farm.

In table 3 the soils in the county have been rated according to their potential as habitats for the principal kinds of game. The ratings given—*high*, *medium*, and *low*—take into account the characteristics and productivity of the soils, the topography, land use, and the kind of vegetation and habitat preferred by the species concerned. The table can be used along with the section "Descriptions of the Soils" and with the detailed soil map at the back of

the report to determine the suitability of the soils for various kinds of habitats. The kinds of habitat preferred by the various species of game are discussed in the paragraphs that follow. Made land mapping units are not included in the table, because of the variability of the soil material in the various units.

Pheasant prefer large areas of fertile farmland, especially areas where corn or small grain is grown. Apparently, they do best on soils that are high in lime. The widespread practice of liming soils for agriculture may, therefore, cause pheasant to come into an area that normally would be poorly suited to them. Pheasant like grassy areas for nesting, but, generally, their numbers decrease where grassland farming is practiced.

Bobwhite are most abundant in areas where small fields that are planted to corn or small grain adjoin meadows and brushy areas. They are less numerous in areas where open farmland is extensive, in areas where grassland farm-

TABLE 3.—*Soils rated according to their potential as habitats for the stated species of game*

Soil	Pheasant	Bobwhite	Mourning dove	Cottontail rabbit	Gray squirrel	Deer
Andover AvB.	Low	Medium	Low	Medium	Medium	Medium.
Atkins Aw, AxA.	Medium	Low	Low	Medium	Low	Medium.
Bedford BdA, BdB, BdB2.	High	High	High	High	Medium	Medium.
Bedford and Lawrence BeA, BeB.	Low	Medium	Low	Medium	Medium	Medium.
Brandywine BfB2, BfC2, BfC3, BfD2, BfD3, BfE3.	Low	Medium	Medium	Medium	High	Medium.
Buchanan gravelly loam BgB, BgB2.	Medium	Low	Low	Medium	High	Medium.
Buchanan very stony loam BhB, BhD.	Low	Low	Low	Low	High	High.
Chester gravelly silt loam CgA2, CgB, CgB2, CgB3, CgC, CgC2, CgC3, CgD, CgD2, CgD3, CgE, CgE2, CgE3.	High	Medium	Medium	Medium	Medium	Medium.
Chester very stony silt loam ChB, ChD, ChF.	Low	Low	Low	Low	High	High.
Comly CmA, CmB, CmB2, CmC2.	Medium	Medium	Medium	Medium	Medium	Medium.
Croton silt loam CrA, CrB.	Medium	Low	Low	Medium	Medium	Medium.
Croton very stony loam CsB.	Low	Low	Low	Low	High	High.
Duffield DuA2, DuB2, DuC2, DuD2, DuD3, DuE2, DuF2, DvA, DvA2, DvB, DvB2.	High	High	High	High	Medium	Medium.
Elk EkA.	High	Medium	High	Medium	Low	Low.
Extremely stony land Es.	Low	Low	Low	Low	Low	Low.
Fleetwood gravelly loam FgB2, FgC2, FgC3, FgD2, FgD3, FgE2.	Low	Medium	Low	Medium	Medium	Medium.
Fleetwood very stony loam FhB, FhD, FhF.	Low	Low	Low	Low	High	High.
Glenville GnA, GnA2, GnB, GnB2, GnC, GnC2.	Medium	Medium	Medium	Medium	Medium	Medium.
Huntington Hn.	High	Medium	Medium	Medium	Medium	Medium.
Klinesville KnB2, KnC2, KnD3, KnE3.	Low	Low	Medium	Medium	Low	Low.

TABLE 3.—*Soils rated according to their potential as habitats for the stated species of game*—Continued

Soil	Pheasant	Bobwhite	Mourning dove	Cottontail rabbit	Gray squirrel	Deer
Laidig gravelly loam LaB2.	Medium	Medium	Medium	High	High	High.
Laidig very stony loam LdB, LdD.	Low	Low	Low	Medium	High	High.
Lindside Ln.	Medium	Medium	Low	Medium	Medium	Medium.
Melvin Mh, MkA, MkB.	Medium	Medium	Low	Low	Low	Medium.
Monongahela MlA, MlB2.	Low	Medium	Medium	Medium	Medium	Medium.
Montalto silt loam MmB2, MmC2, MmC3, MmD2, MmD3, MmE3.	Medium	High	Medium	High	High	High.
Montalto very stony loam MnB, MnD, MnE.	Low	Low	Low	Low	High	High.
Montevallo channery silt loam MoB2, MoC2, MoC3, MoD2, MoD3, MoE2, MoE3, MoF2, MoF3.	Medium	Medium	Medium	Medium	Medium	Medium.
Montevallo very rocky silt loam MsD, MsF.	Low	Low	Low	Low	High	High.
Murrill gravelly loam MuB2, MuC2, MuC3.	High	High	High	High	High	Medium.
Murrill very stony loam MvB, MvD.	Low	Low	Low	Low	Medium	High.
Norton NtA, NtB2, NtC2, NtD2.	High	Medium	High	Medium	High	Medium.
Penn PeB, PeB2, PeC2, PeC3, PeD2, PeD3, PeE2, PeE3.	Medium	Medium	Medium	Medium	Medium	Medium.
Philo Ph.	Medium	Medium	Low	High	Medium	Medium.
Readington RdA, RdB, RdB2, RdC2.	Medium	Medium	Low	Medium	Medium	Medium.
Riverwash Rv.	Low	Low	Low	Low	Low	Low.
Ryder RyA, RyB2, RyC2, RyC3, RyD3, RyE3.	High	High	High	High	Low	Low.
Shelmadine ShA, ShB, ShB2, ShC2.	Medium	Low	Low	Medium	Medium	Medium.
Trexler TrA, TrB2, TrB3, TrC2, TrC3, TrD2, TrD3, TsA2, TsB2, TsB3, TsC2, TsC3, TsD2, TsD3, TsE2, TsE3.	Medium	Medium	Medium	Medium	Medium	Medium.
Washington WcB2, WcC3, WgA, WgA2, WgB, WcC2, WgB2, WgC, WgC2, WgC3, WgD2.	High	High	High	High	High	High.
Wheeling Wha, WhB2, WhC2.	High	Medium	High	High	Low	Low.
Woodglen WoA, WoB, WrB.	Medium	Medium	Low	Medium	Medium	Medium.
Worsham WsA, WsA2, WsB, WsB2.	Low	Low	Medium	Medium	Medium	High.

ing is practiced, or in mature forests. The mourning dove, on the other hand, thrives where there are large fields of corn and small grain.

The cottontail rabbit thrives in most habitats, but they are most abundant in brushy areas that are interspersed with patches of grass. The cottontail rabbit is least abundant in large areas that are cultivated or that have a dense cover of trees.

Gray squirrel generally prefer wooded areas where there are many oaks, hickories, and other trees that bear nuts. They are most abundant in woodlands that have a heavy undergrowth, but they generally prefer to live near the edges and openings of woods.

White-tailed deer generally like second- and third-growth hardwood forests, brushy areas, and the edges of open fields.

Engineering Uses of the Soils

This soil survey report for Lehigh County, Pa., contains information that can be used by engineers to—

(1) Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
(2) Assist in designing drainage and irrigation systems, farm ponds, diversion terraces, and other structures for soil and water conservation.
(3) Aid in determining the suitability of sites for disposal of liquid waste from processing plants and effluent from septic tanks.
(4) Estimate the kind of material that will be encountered when excavating for buildings and other structures.
(5) Make preliminary surveys of soil and ground conditions that will aid in selecting locations for highways and airports and in planning detailed surveys of the soils at the selected locations.
(6) Locate sand and gravel for use in structures.
(7) Correlate pavement performance with the soil mapping units and thus develop information that will be useful in designing and maintaining pavements.
(8) Determine the suitability of soil units for cross-country movements of vehicles and construction equipment.
(9) Estimate the suitability of sites for pipelines and communications cables.
(10) Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.

The mapping and the descriptive report are somewhat generalized and should be used only in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed engineering construction.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, and sand—may have special meanings in soil science. These and other special terms that are used are defined in the Glossary at the end of the report.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils of high bearing capacity, to A–7, which consists of clay soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses, following the soil symbol, in table 6.

Some engineers prefer to use the Unified soil classification system (*23*). In this system soil materials are identified as coarse grained, eight classes; fine grained, six classes; and highly organic. The last column of table 6 gives the classification of the tested soils of Lehigh County according to the Unified system.

Engineering properties and engineering interpretations

The properties of the soils and the interpretations that are the most significant to engineers are presented in tables 4, 5, and 6. Additional information helpful to engineers can be obtained from the detailed soil map and the general soil map. For some information, however, it may be necessary to refer to other parts of the report, particularly to the section "Descriptions of the Soils."

The descriptions of the soil profiles, as well as the soil map, should be used in planning a detailed survey at the construction site. These will help the engineer to concentrate on the most suitable soils, indicate sources of sand and gravel, and minimize the number of soil samples needed for testing in the laboratory.

A brief explanation of how the information in the tables was obtained and an explanation of the significance of some of the items follows:

Estimated properties of the soils.—Table 4 gives a brief description of the soils of Lehigh County and their estimated physical properties. The properties are those of the average soil profiles, which are divided into layers significant to engineering. Where test data are available, the average values from table 6 are shown. Where tests were not performed, the estimates shown are based on test data obtained from similar soils in this county or test data obtained for these soils from other counties and by past experience in engineering construction. Since the estimates are only for the average soils, considerable variation from these values should be anticipated. More information on the range of properties of the soils can be obtained in other sections of the report.

The map symbols and the names of the soils are listed alphabetically in table 4, and depth to a seasonally high water table and to bedrock is indicated. In the column that shows depth from surface, the layers indicated are fairly typical of the layers in all the soils of any one series. The depths indicated, however, are not identical with those in the representative profile for that particular series, given in the section "Descriptions of the Soils."

The engineering soil classifications given in table 4 are based on the soil material below a depth of 6 to 10 inches. The soil material above that depth generally contains too

much organic matter to be suitable for use in engineering structures.

The permeability of the soil is based on the rate of movement of water through the soil material in its undisturbed state. It depends largely upon the soil texture and structure.

The available moisture capacity, in inches per inch of soil depth, is the approximate amount of capillary water in the soil when it is wet to field capacity. When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Shrink-swell potential is an indication of the volume change to be expected with a change in moisture content. It is estimated primarily on the basis of the amount and type of clay present. In general, soils classified as CH and A–7 have high shrink-swell potential. Clean sand and gravel (single-grain structure) and those soils having small amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have low shrink-swell potential.

Engineering interpretations.—In table 5 the soils of the county are rated according to their suitability for engineering construction. The ratings given include a rating for suitability for winter grading, for susceptibility to frost heaving, for suitability of the soil material for road subgrade and road fill, for suitability as a source of topsoil and of sand, gravel, and stone, and for use in various kinds of construction.

The suitability of soils for winter grading depends largely upon the texture of the soil material, its natural content of water, and the depth to the water table during winter. Clay soils are difficult to handle when wet and must be dry enough so that they can be compacted. Also, when clay soils are frozen, they may be difficult to excavate and should not be used in the compacted road section. Therefore, clay soils are rated *poor*. Fine sands and silts that have a high water table during the freezing period are rated *very poor*. In these soils, extensive ice lenses can develop, and if the frozen material is placed in the compacted road section, differential settlement may occur in the embankments when the ice melts.

The susceptibility of a soil to frost action depends upon the texture of the soil material and the depth to the water table during the freezing period. Silts and fine sands that have a high water table are rated *high*.

The suitability of the soil material for road subgrade and road fill depends largely upon the texture of the soil material and its natural content of water. Highly plastic soil materials are rated *poor* for road subgrade and *poor* or *fair* for road fill, depending upon the natural content of water, the time it takes for the materials to dry, and the difficulty of handling and compacting the soil materials. Fine sands and silty soils are difficult to compact, are highly erodible, require moderately gentle slopes, and need to be seeded to vegetation that grows rapidly and provides a good cover. Therefore, these soils are rated *poor* for road subgrade and *fair* for road fill.

In determining the suitability of the soils for the vertical alinement of highways, the kind of material, as well as the drainage, must be considered carefully. If highway cuts are planned at a location where there is a perched water table, a survey should be made to determine the need for interceptor drains and underdrains. Seepage on the back slope of cuts may cause slumping or sliding of the underlying material until the soil material has become stable, even when it is wet.

Shallowness to bedrock and the presence of boulders or highly plastic clays in the soil all influence the vertical alinement of highways. So do a high degree of erodibility in cut sections, high water table, and some other features mentioned in the brief description of soils in table 4.

If the perched water table is just below the pavement, ice may form in the soil in winter. The resulting differential volume change may cause displacement of the pavement and the fill. The greatest displacement generally occurs along the line that marks the boundary between two soils that have different drainage. In such areas thawing of the ice lenses in spring removes the support, and, as a result, the pavement will shift and break. During the period when thawing is taking place, the subgrade is usually saturated; thus, the bearing capacity or stability of the subgrade is reduced and the pavement deteriorates further.

Impounded water seeps through earth dams in some areas in Lehigh County. Some soils, especially the Duffield and Washington soils developed on limestone, do not retain their ability to hold water after mechanical compaction. They have a strong tendency to form aggregates. The water seeps out between the aggregates and through the compacted zone. The porous substratum and the solution channels in the bedrock encourage water to move away from the impoundment area.

Before constructing a pond, the site should be carefully inspected for active sinkholes or for evidence of earth settlement. If there is any sign of a sinkhole, the area is unsuitable for a pond. Areas that have rock ledges or areas where bedrock will be less than 2 feet below the bottom of the pond should be avoided as sites for ponds.

Soil test data

To help evaluate the soils for engineering purposes, soil samples from the principal soil types of each of several extensive soil series were tested in accordance with established procedures by AASHO (*1*). The test data are given in table 6.

The engineering classifications in table 6 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Percentages of silt and clay determined by the hydrometer method should not be used in naming textural classes for soil classification. The information, however, is useful in determining general engineering properties of the soils.

The tests to show liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid or plastic state. As the moisture content is further increased, the material changes from the plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a solid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

TABLE 4.—*Brief description of the soils of Lehigh*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
AvB	Andover very stony sandy loam, 0 to 8 percent slopes.	0–½	4–30	Poorly drained sandy loam to silt loam that is 4 to 30 feet thick and developed from colluvium at the foot of Blue Mountain; the colluvium was derived from quartzite and shale; the soil contains many cobbles and boulders that cover 3 to 15 percent of the acreage; the water table is high.	0–30 30–60
Aw AxA	Atkins silt loam. Atkins silt loam, local alluvium, 0 to 3 percent slopes.	0	3–35	Poorly drained silt loam and silty clay loam that is 3 to 35 feet thick; subject to frequent overflow.	0–48
BdA BdB BdB2	Bedford silt loam, 0 to 3 percent slopes. Bedford silt loam, 3 to 8 percent slopes. Bedford silt loam, 3 to 8 percent slopes, moderately eroded.	1½	4–15	Moderately well drained silt and silty clay loam that is 4 to 15 feet thick over limestone and cement rock; the water table is high in spring.	0–30 30–120
BeA BeB	Bedford and Lawrence silt loams, 0 to 3 percent slopes. Bedford and Lawrence silt loams, 3 to 8 percent slopes.	1	5–15	Moderately well drained to somewhat poorly drained silt loam to silty clay loam that is 5 to 15 feet thick over limestone.	0–20 20–120
BfB2 BfC2 BfC3 BfD2 BfD3 BfE3	Brandywine loam, 3 to 8 percent slopes, moderately eroded. Brandywine loam, 8 to 15 percent slopes, moderately eroded. Brandywine loam, 8 to 15 percent slopes, severely eroded. Brandywine loam, 15 to 25 percent slopes, moderately eroded. Brandywine loam, 15 to 25 percent slopes, severely eroded. Brandywine loam, 25 to 35 percent slopes, severely eroded.	3+	1–3	Well-drained loam to gravelly sandy loam that is 1 to 3 feet thick and is on uplands; underlain by granite and gneiss; in some places 30 percent consists of cobbles and some boulders.	0–16
BgB BgB2 BhB BhD	Buchanan gravelly loam, 3 to 8 percent slopes. Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded. Buchanan very stony loam, 0 to 8 percent slopes. Buchanan very stony loam, 8 to 25 percent slopes.	1½	4–30	Moderately well drained silt loam or loam that is 4 to 20 feet thick; contains many cobbles and pebbles and a few sandstone boulders that are as much as 2 feet in diameter; this soil overlies quartzite and shale and is along the foot of Blue Mountain; the water table is near the surface during the wet part of the year.	0–24 24–60
CgA2 CgB CgB2 CgB3 CgC CgC2 CgC3 CgD CgD2 CgD3 CgE CgE2 CgE3	Chester gravelly silt loam, 0 to 3 percent cent slopes, moderately eroded. Chester gravelly silt loam, 3 to 8 percent slopes. Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded. Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded. Chester gravelly silt loam, 8 to 15 percent slopes. Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded. Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded. Chester gravelly silt loam, 15 to 25 percent slopes. Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded. Chester gravelly silt loam, 15 to 25 percent slopes, severly eroded. Chester gravelly silt loam, 25 to 35 percent slopes. Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded. Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded.	3+	4–20	Well-drained silt loam and silty clay loam that is 4 to 10 feet thick and is underlain by glaciated granite, granitic gneiss, and schist; variable amounts, as much as 35 percent, of pebbles 1 to 3 inches in diameter are on the surface and throughout the profile; the very stony areas have many cobbles and boulders that range from 3 inches to 4 feet in diameter.	0–36 36–72

See footnotes at end of table.

County, Pa., and their estimated physical properties [1]

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
SM-GM	A-2	40-55	35-50	25-35	0. 2 -0. 63	0. 10	5. 0	15	120	Low.
SM-GM	A-2	40-55	35-50	25-35	0. 63-2. 0	. 10	5. 0	15	120	Low.
ML to MH	A-6, A-7	85-95	70-85	55-70	0. 2 -0. 63	. 15	5. 8	18	108	Medium.
ML-CL	A-4 to A-7	85-95	75-90	65-80	0. 63-2. 0	. 12	6. 5	16	111	Low to medium.
ML-CL	A-4 to A-6	85-95	80-95	75-85	0. 2 -0. 63	. 12	6. 8	18	107	Low to medium.
CL	A-6	100	100	85-95	0. 63-2. 0	. 18	6. 5	16	110	Medium.
CL	A-6	100	100	85-95	0. 2 -0. 63	. 12	6. 8	17	108	Medium.
SC	A-2	70-90	60-80	20-30	2. 0-6. 3	. 10	5. 0	12	105	Low.
SM-GM	A-2	45-60	40-55	20-30	0. 63-2. 0	. 10	5. 0	15	112	Low.
SM-GM	A-2	50-70	45-60	25-35	0. 63-2. 0	. 15	5. 0	15	112	Low.
ML	A-4 to A-5	85-95	75-90	55-65	0. 63-2. 0	. 15	6. 0	17	110	Low.
SM	A-2	85-95	75-90	20-30	0. 63-2. 0	. 15	5. 0	13	118	Low.

TABLE 4.—*Brief description of the soils of Lehigh County,*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
ChB	Chester very stony silt loam, 0 to 8 percent slopes.				
ChD	Chester very stony silt loam, 8 to 25 percent slopes.				
ChF	Chester very stony silt loam, 25 to 50 percent slopes.				
CmA	Comly silt loam, 0 to 3 percent slopes.	1½	2–6	Moderately well drained shaly silt loam to silty clay loam that is 2 to 6 feet thick; underlain by shale and thin-bedded sandstone; the water table is high in spring and early in summer.	0–30
CmB	Comly silt loam, 3 to 8 percent slopes.				30–60
CmB2	Comly silt loam, 3 to 8 percent slopes, moderately eroded.				
CmC2	Comly silt loam, 8 to 15 percent slopes, moderately eroded.				
CrA	Croton silt loam, 0 to 3 percent slopes.	0	2½–8	Poorly drained silt loam to silty clay loam that is 2 to 8 feet thick; underlain by red shale and sandstone; the water table is high throughout most of the year; 3 to 15 percent of some areas is covered by cobbles and boulders.	0–30
CrB	Croton silt loam, 3 to 8 percent slopes.				30–60
CsB	Croton very stony loam, 0 to 8 percent slopes.				
DuA2	Duffield silt loam, 0 to 3 percent slopes, moderately eroded.	3+	2½–8	Well-drained silt loam and silty clay loam that is 2½ to 8 feet thick and is underlain by impure limestone; contains varying amounts of rock fragments, but generally no more than 5 to 10 percent; in a few places ledges of bedrock are close to the surface.	0–36
DuB2	Duffield silt loam, 3 to 8 percent slopes, moderately eroded.				36–60
DuC2	Duffield silt loam, 8 to 15 percent slopes, moderately eroded.				
DuD2	Duffield silt loam, 15 to 25 percent slopes, moderately eroded.				
DuD3	Duffield silt loam, 15 to 25 percent slopes, severely eroded.				
DuE2	Duffield silt loam, 25 to 35 percent slopes, moderately eroded.				
DuF2	Duffield silt loam, 35 to 55 percent slopes, moderately eroded.				
DvA	Duffield silt loam, low clay variant, 0 to 3 percent slopes.	3+	3½–8	Well-drained silt loam and silty clay loam that is 3½ to 8 feet thick and is underlain by shaly limestone, locally called cement rock; contains only a few coarse fragments.	0–42
DvA2	Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded.				42–72
DvB	Duffield silt loam, low clay variant, 3 to 8 percent slopes.				
DvB2	Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded.				
EkA	Elk silt loam, 0 to 3 percent slopes.	3+	4–15	Well-drained silt loam and silty clay loam that is 4 to 15 feet thick and is on stream terraces of uplands underlain by limestone; locally, a few pebbles are in this soil, and in some places there is stratification with fine sand and silt.	0–36
					36–120
Es	Extremely stony land.	10+	0–5	Areas of rock slides, rock outcrops, and other extremely stony areas of which more than 90 percent is covered with boulders that range from 1 foot to 20 feet in diameter; the areas have little or no soil material.	0–36+
FgB2	Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded.	5+	3–5	Well-drained gravelly and very stony loam, that is 3 to 5 feet thick and is underlain by sandstone and quartzite; the very stony soils have large boulders on the surface and throughout the profile.	0–40
FgC2	Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded.				40–60
FgC3	Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded.				
FgD2	Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded.				
FgD3	Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded.				
FgE2	Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded.				
FhB	Fleetwood very stony loam, 0 to 8 percent slopes.				

See footnotes at end of table.

Pa., and their estimated physical properties [1]—Continued

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
CL	A-4, A-6	85-95	75-90	55-70	0. 63-2. 0	0. 12	5. 0	18	108	Low to medium.
CL	A-4, A-6	75-90	70-85	55-65	0. 63-2. 0	. 12	5. 0	18	108	Low to medium.
CL	A-7	90-100	90-100	85-95	0. 2-0. 63	. 14	5. 2	19	103	Medium.
CL	A-7	90-100	90-100	80-95	<0. 2	. 10	5. 2	15	112	Medium.
CL	A-7	90-100	90-100	80-95	0. 63-2. 0	. 15	7. 0	18	108	Medium.
ML-CL	A-7	90-100	90-100	80-95	0. 63-2. 0	. 15	7. 0	19	107	Medium.
ML	A-5 to A-7	85-95	80-95	70-85	0. 63-2. 0	. 15	6. 5	17	101	Low.
ML	A-5 to A-7	85-90	80-90	65-75	0. 63-2. 0	. 15	6. 5	20	101	Low.
CL, ML	A-5 to A-7	90-100	85-95	70-90	0. 63-2. 0	. 15	7. 0	18	110	Low to medium.
ML-CL, ML	A-5 to A-7	85-100	90-95	70-90	0. 63-2. 0	. 15	7. 0	19	108	Low to medium.
		<25	<15	<5	>6. 3					
SM-SC to GM.	A-1 to A-2	50-70	40-60	20-30	2. 0-6. 3	. 10	5. 0	13	118	Low.
GW-GM, GC to GM-GC.	A-1	35-50	25-35	10-20	0. 63-2. 0	. 08	5. 0	12	123	Low.

TABLE 4.—*Brief description of the soils of Lehigh County,*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
FhD	Fleetwood very stony loam, 8 to 25 percent slopes.				
FhF	Fleetwood very stony loam, 25 to 60 percent slopes.				
GnA	Glenville silt loam, 0 to 3 percent slopes.	1½	3–20	Moderately well drained silt loam to silty clay loam that is 3 to 10 feet thick and contains a few cobbles; underlain by granite and gneiss; the water table is near the surface in spring and early in summer.	0–30
GnA2	Glenville silt loam, 0 to 3 percent slopes, moderately eroded.				30–60
GnB	Glenville silt loam, 3 to 8 percent slopes.				
GnB2	Glenville silt loam, 3 to 8 percent slopes, moderately eroded.				
GnC	Glenville silt loam, 8 to 15 percent slopes.				
GnC2	Glenville silt loam, 8 to 15 percent slopes, moderately eroded.				
Hn	Huntington silt loam.	1–2	4–8	Well-drained silt loam and stratified sand and gravel that is 4 to 8 feet thick and is along stream bottoms; subject to occasional overflow.	0–36
					36–60
KnB2	Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded.	3+	½–1½	Well-drained shaly silt loam that is ½ to 1½ feet thick and overlies red shale; the shale is thin bedded, but is hard and slaty.	0–12
KnC2	Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded.				
KnD3	Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded.				
KnE3	Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded.				
LaB2	Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded.	3+	4–20	Well-drained silt loam that is 4 to 20 feet thick; contains many pebbles and cobbles and a few sandstone boulders that are as much as 3 feet in diameter; formed in colluvial and alluvial materials on the lower slopes of mountains; a moderate pan is at a depth below 36 inches; the nonstony soils have had the boulders and large cobbles removed from the surface.	0–36
LdB	Laidig very stony loam, 0 to 8 percent slopes.				36–60
LdD	Laidig very stony loam, 8 to 25 percent slopes.				
Ln	Lindside silt loam.	1	4–70	Moderately well drained silt loam that is 4 to 70 feet thick; in some places there is stratification with layers of sand and gravel; the areas are subject to overflow.	0–36
					36–84
MaB	Made land, granitic material, 0 to 8 percent slopes.	(1)	(1)	Soil material and rock that extend to varying depths and that have been artificially disturbed; the areas range from deep cuts to deep fills of mixed gneiss and granitic material.	(1)
MaD	Made land, granitic material, 8 to 25 percent slopes.				
MeA	Made land, limestone material, 0 to 3 percent slopes.	(1)	(1)	Soil material, glacial till, and limestone that extend to varying depths and that have been artificially disturbed; the areas range from exposed bedrock to deep fill; there are also quarry spoil banks.	(1)
MeB	Made land, limestone material, 3 to 8 percent slopes.				
MeD	Made land, limestone material, 8 to 25 percent slopes.				
MfB	Made land, shale material, 0 to 8 percent slopes.	(1)	(1)	Soil material and rock that extend to varying depths and that have been artificially disturbed; the areas range from deep cuts to deep fills of shaly and slaty material.	(1)
MfD	Made land, shale material, 8 to 25 percent slopes.				
Mh	Melvin silt loam.	0	4–70	Poorly drained silt loam that is 4 to 70 feet thick, but in places has spots of silty clay loam; subject to overflow.	0–48
MkA	Melvin silt loam, local alluvium, 0 to 3 percent slopes.				
MkB	Melvin silt loam, local alluvium, 3 to 8 percent slopes.				
MlA	Monongahela silt loam, 0 to 3 percent slopes.	1½	5–40	Moderately well drained silt loam and silty clay loam that is 5 to 40 feet thick; there is a brittle pan at a depth between 24 and 36 inches.	0–36
MlB2	Monongahela silt loam, 3 to 8 percent slopes, moderately eroded.				36–120

See footnotes at end of table.

Pa., and their estimated physical properties [1]—Continued

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
ML	A-4 to A-5	90–100	80–95	55–65	0. 63–2. 0	0. 12	5. 0	17	110	Low.
ML	A-2	85–95	75–90	25–35	0. 63–2. 0	. 12	5. 0	13	118	Low.
ML	A-4	85–95	65–80	55–70	2. 0–6. 3	. 18	6. 3	18	108	Low.
SM, GM	A-1, A-2	80–95	30–60	10–25	2. 0–6. 3	. 18	6. 1	11	120	Low.
GM–GC	A-2	20–40	15–30	5–15	2. 0–6. 3	. 05	5. 6	12	122	Low.
ML	A-4	80–95	70–90	55–65	0. 63–2. 0	. 14	5. 3	13	115	Low.
ML	A-4	80–95	70–90	50–60	0. 2–0. 63	. 12	5. 4	14	115	Low.
ML	A-4	75–90	65–75	55–65	0. 63–2. 0	. 18	6. 2	16	110	Low.
GM, SM, ML	A-4	60–80	55–65	40–60	0. 2–0. 63	. 18	6. 0	16	110	Low.
[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4].
[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4].
[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4].
ML, MH	A-6	85–95	80–95	70–90	0. 2–0. 63	. 15	6. 0	18	108	Medium.
ML, CL	A-4	85–95	80–90	60–70	0. 2–0. 63	. 15	5. 2	13	115	Low.
ML, CL	A-4	80–90	75–85	55–70	0. 2–0. 63	. 10	5. 2	13	115	Low.

TABLE 4.—*Brief description of the soils of Lehigh County,*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
MmB2	Montalto silt loam, 3 to 8 percent slopes, moderately eroded.	3+	2½–10	Well-drained, moderately plastic and sticky silty clay loam that is 2½ to 10 feet thick and overlies well-drained, less plastic clay loam; the very stony soils contain 3 to 30 percent of boulders that are as much as 8 feet in diameter.	0–30
MmC2	Montalto silt loam, 8 to 15 percent slopes, moderately eroded.				30–48
MmC3	Montalto silt loam, 8 to 15 percent slopes, severely eroded.				
MmD2	Montalto silt loam, 15 to 25 percent slopes, moderately eroded.				
MmD3	Montalto silt loam, 15 to 25 percent slopes, severely eroded.				
MmE3	Montalto silt loam, 25 to 35 percent slopes, severely eroded.				
MnB	Montalto very stony loam, 0 to 8 percent slopes.				
MnD	Montalto very stony loam, 8 to 25 percent slopes.				
MnE	Montalto very stony loam, 25 to 35 percent slopes.				
MoB2	Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded.	3+	¼–3	Well-drained, frost-churned or broken, shaly and silty soil material that is ¼ foot to 3 feet thick and overlies the Martinsburg formation; coarse fragments occupy from 40 to 90 percent by volume and range from 1 inch to 10 inches in diameter; in places cobbles and boulders washed from other areas have accumulated on the surface.	0–12
MoC2	Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded.				12–36
MoC3	Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded.				
MoD2	Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded.				
MoD3	Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded.				
MoE2	Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded.				
MoE3	Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded.				
MoF2	Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded.				
MoF3	Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded.				
MsD	Montevallo very rocky silt loam, 8 to 25 percent slopes.				
MsF	Montevallo very rocky silt loam, 25 to 65 percent slopes.				
MuB2	Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded.	5+	5–40	Well-drained gravelly loam that is 2 or more feet thick and contains sandstone and quartzite gravel; overlies 3 or more feet of a fine-textured, more plastic soil material; underlain by limestone.	0–36
MuC2	Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded.				36–84
MuC3	Murrill gravelly loam, 8 to 15 percent slopes, severely eroded.				
MvB	Murrill very stony loam, 0 to 8 percent slopes.				
MvD	Murrill very stony loam, 8 to 25 percent slopes.				
NtA	Norton silt loam, 0 to 3 percent slopes.	3+	2½–5	Well-drained silt loam or silty clay loam that is 2½ to 5 feet thick and is underlain by weathered shale, siltstone, and soft sandstone.	0–30
NtB2	Norton silt loam, 3 to 8 percent slopes, moderately eroded.				30–60
NtC2	Norton silt loam, 8 to 15 percent slopes, moderately eroded.				
NtD2	Norton silt loam, 15 to 25 percent slopes, moderately eroded.				
PeB	Penn shaly silt loam, 3 to 8 percent slopes.	3+	1–3	Well-drained shaly silt loam that is 1 to 3 feet thick over red shale and thin sandstone.	0–20
PeB2	Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded.				20–36
PeC2	Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded.				
PeC3	Penn shaly silt loam, 8 to 15 percent slopes, severely eroded.				
PeD2	Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded.				

See footnotes at end of table.

Pa., and their estimated physical properties [1]—Continued

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
MH	A-7	90–100	85–95	80–95	0. 63–2. 0	0. 12	6. 0	26	91	Medium to high.
MH	A-7	90–100	90–95	80–90	0. 63–2. 0	. 12	6. 0	29	89	Medium to high.
SM–GM	A-1 to A-2	30–60	20–40	10–20	2. 0–6. 3	. 12	6. 5	15	113	Low.
GP–GM	A-1 to A-2	30–40	15–25	5–15	0. 63–2. 0	. 04	6. 5	14	116	Low.
ML, CL	A-4, A-6	70–90	70–80	65–75	2. 0–6. 3	. 15	6. 2	19	107	Low to medium.
SC, CL	A-6	70–80	60–70	55–65	0. 63–2. 0	. 15	6. 5	16	111	Medium.
GM	A-4	65–75	60–70	40–50	0. 63–2. 0	. 18	5. 5	14	118	Low.
GC	A-4	60–70	50–60	40–50	0. 2–0. 63	. 15	5. 5	12	121	Low.
ML–CL	A-4	80–95	80–90	70–85	2. 0–6. 3	. 16	5. 2	11	119	Low.
ML–CL	A-4	80–95	75–85	70–80	0. 63–2. 0	. 10	5. 2	11	120	Low.

TABLE 4.—*Brief description of the soils of Lehigh County,*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
PeD3	Penn shaly silt loam, 15 to 25 percent slopes, severely eroded.				
PeE2	Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded.				
PeE3	Penn shaly silt loam, 25 to 40 percent slopes, severely eroded.				
Ph	Philo silt loam.	1	3–20	Moderately well drained silt loam to loam that is 3 to 20 feet thick; formed in recent alluvium along streams; contains occasional pockets of gravel and clay; subject to occasional flooding.	0–72
RdA	Readington silt loam, 0 to 3 percent slopes.	1½	3–6	Moderately well drained silt loam and clay loam that is 3 to 6 feet thick and is on flats and in depressions of the uplands; underlain by shale and thin sandstone.	0–30
RdB	Readington silt loam, 3 to 8 percent slopes.				30–60
RdB2	Readington silt loam, 3 to 8 percent slopes, moderately eroded.				
RdC2	Readington silt loam, 8 to 15 percent slopes, moderately eroded.				
Rv	Riverwash.	0	(4)	Cobbly and gravelly areas along streams and on islands; subject to frequent flooding.	--------
RyA	Ryder silt loam, 0 to 3 percent slopes.	3+	1½–3	Well-drained silt loam and silty clay loam that is 1½ to 3 feet thick and is underlain by shaly limestone.	0–30
RyB2	Ryder silt loam, 3 to 8 percent slopes, moderately eroded.				
RyC2	Ryder silt loam, 8 to 15 percent slopes, moderately eroded.				
RyC3	Ryder silt loam, 8 to 15 percent slopes, severely eroded.				
RyD3	Ryder silt loam, 15 to 25 percent slopes, severely eroded.				
RyE3	Ryder silt loam, 25 to 35 percent slopes, severely eroded.				
ShA	Shelmadine silt loam, 0 to 3 percent slopes.	0	3–8	Poorly drained shaly silt loam to silty clay loam that is 3 to 8 feet thick and is underlain by frost-churned Martinsburg shale and sandstone; plastic and moderately sticky when wet; the water table is seasonally high.	0–36
ShB	Shelmadine silt loam, 3 to 8 percent slopes.				36–72
ShB2	Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded.				
ShC2	Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded.				
TrA	Trexler shaly silt loam, 0 to 3 percent slopes.	3+	3–6	Well-drained shaly silt loam, sand, and silty clay loam that is 3 to 6 feet thick and is underlain by Illinoian glacial till derived from shale and sandstone.	0–36
TrB2	Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded.				36–50
TrB3	Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded.				
TrC2	Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded.				
TrC3	Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded.				
TrD2	Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded.				
TrD3	Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded.				
TsA2	Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded.	5+	1½–3	Well-drained shaly silt loam that is 1½ to 3 feet thick and is underlain by partly weathered slate; small to medium chips of shale in the soils are partly weathered and soft.	0–34
TsB2	Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded.				34–40
TsB3	Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded.				
TsC2	Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded.				

See footnotes at end of table.

Pa., and their estimated physical properties [1]—Continued

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
ML	A-7	90-100	75-90	55-70	0. 63-2. 0	0. 18	5. 5	19	105	Low.
ML-CL	A-4	90-100	85-95	80-90	0. 2-0. 63	. 13	5. 0	17	108	Low.
ML-CL	A-4	90-100	85-95	70-90	<0. 2	. 10	5. 0	14	114	Low.
GP or SM	A-1-a to A-4	(4)	(4)	(4)	2. 0-6. 3			(4)	(4)	Low.
ML	A-5 to A-7	85-95	80-90	70-85	0. 63-2. 0	. 15	6. 5	17	101	Low.
CL	A-6	90-100	80-95	75-85	0. 2-0. 63	. 12	5. 5	18	110	Medium.
ML	A-4	80-90	75-85	70-80	<0. 2	. 10	5. 5	15	115	Low.
ML, CL	A-4 to A-6	75-85	65-80	45-55	0. 63-2. 0	. 15	6. 0	16	113	Medium.
SM-SC, GM-GC.	A-4	60-75	50-65	25-35	0. 63-2. 0	. 10	5. 0	14	116	Low.
SM-SC to SM-SC-GM-GC.	A-2 to A-4	50-70	40-60	25-35	2. 0-6. 3	. 10	6. 0	15	130	Low.
SM to GM	A-1 to A-2	40-60	30-50	20-30	0. 63-2. 0	. 05		16	129	Low.

TABLE 4.—*Brief description of the soils of Lehigh County,*

Map symbol	Soil	Depth to seasonally high water table	Depth to bedrock	Brief description of soil	Depth from surface
		Feet	*Feet*		*Inches*
TsC3	Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded.				
TsD2	Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded.				
TsD3	Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded.				
TsE2	Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded.				
TsE3	Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded.				
WcB2	Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded.	6+	4–60	Well-drained, loose, gravelly glacial till or terrace material that is 4 to 60 feet thick over limestone, shale, and sandstone.	0–40
WcC2	Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded.				40–144
Wga	Washington silt loam, 0 to 3 percent slopes.	3+	3–15	Well-drained silt loam and silty clay loam that is 3 to 15 feet thick and contains gravel in places; formed in Illinoian glacial till derived from limestone.	0–36
WgA2	Washington silt loam, 0 to 3 percent slopes, moderately eroded.				36–84
WgB	Washington silt loam, 3 to 8 percent slopes.				
WgB2	Washington silt loam, 3 to 8 percent slopes, moderately eroded.				
WgC	Washington silt loam, 8 to 15 percent slopes.				
WgC2	Washington silt loam, 8 to 15 percent slopes, moderately eroded.				
WgC3	Washington silt loam, 8 to 15 percent slopes, severely eroded.				
WgD2	Washington silt loam, 15 to 25 percent slopes, moderately eroded.				
WhA	Wheeling gravelly loam, 0 to 3 percent slopes.	4+	4–12	Well-drained gravelly loam that is 4 to 12 feet thick and formed in stream terrace deposits; contains 10 to 30 percent of shale and sandstone gravel.	0–36
WhB2	Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded.				36–96
WhC2	Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded.				
WoA	Woodglen silt loam, 0 to 3 percent slopes.	0	4–12	Very poorly drained silty clay that is 4 to 12 feet thick and contains occasional cobbles; underlain by granite and gneiss; the water table is high throughout the year.	0–30
WoB	Woodglen silt loam, 3 to 8 percent slopes.				30–72
WrB	Woodglen very stony silt loam, 0 to 8 percent slopes.				
WsA	Worsham silt loam, 0 to 3 percent slopes.	0	4–10	Poorly drained silt loam and silty clay loam that is 4 to 10 feet thick and contains gravel and cobbles in places; underlain by granite and gneiss; the water table is high throughout most of the year.	0–30
WsA2	Worsham silt loam, 0 to 3 percent slopes, moderately eroded.				30–84
Wsb	Worsham silt loam, 3 to 8 percent slopes.				
WsB2	Worsham silt loam, 3 to 8 percent slopes, moderately eroded.				

[1] Properties given for the Chester, Duffield, Fleetwood, Montevallo, Trexler, and Washington soils are based on data given in table 6.

[2] The amount of available moisture in an inch of soil material in the designated horizons shown in column that gives depth from surface. This amount of water will wet the soil material described to a depth of 1 inch without further percolation.

Pa., and their estimated physical properties [1]—Continued

Classification		Percentage passing sieve—			Permeability	Available moisture capacity [2]	Reaction	Optimum moisture for compaction	Maximum dry density [3]	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200						
					Inches per hour	*Inches per inch*	*pH*	*Percent*	*Pounds per cubic foot*	
SC-SM	A-2-4 to A-2-7.	65-80	50-70	25-35	2.0-6.3	0.12	6.5	15	111	Low.
SC, GM	A-2-4 to A-2-7.	50-65	40-50	15-30	2.0-6.3	.10	6.8	15	113	Low.
ML-CL	A-4 to A-7	90-100	80-90	65-80	0.63-2.0	.15	6.5	16	111	Low to medium.
ML-ML-CL	A-4 to A-6	90-100	85-95	75-90	0.63-2.0	.15	6.8	18	107	Low to medium.
SM	A-4	100	100	35-50	2.0-6.3	.15	5.3	10	124	Low.
GP-GC	A-2	40-60	30-50	5-15	0.63-2.0	.08	5.0	9	127	Low.
ML	A-4	80-90	70-80	65-75	<0.2	.12	5.5	18	108	Medium.
ML	A-4	80-90	70-80	65-75	<0.2	.12	5.5	18	108	Medium.
MH	A-7	80-90	75-85	65-75	<0.2	.12	5.0	15	109	Medium to high.
ML	A-7	75-90	60-75	55-65	<0.2	.12	5.0	15	109	Low to medium.

[3] Estimates are based on AASHO designation T 99-57, Method A, in which only the material passing the No. 4 sieve is compacted. For those soils containing material retained on the No. 4 sieve, the optimum moisture will be lower and the maximum dry density higher than these estimated values.

[4] Variable.

TABLE 5.—*Suitability and characteristics of the*

[The characteristics are those that cause difficulty in the stated kind of construction. Dashes

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost heaving	Suitability of soil material for—		Suitability as source of—		Characteristics that affect—	
			Road subgrade	Road fill	Topsoil	Sand, gravel, and stone	Vertical alinement for highways	
							Materials	Drainage
Andover (AvB)	Poor	High	Fair	Fair	Poor	Unsuitable.	Instability.	High water table.
Atkins (Aw, AxA)	Very poor.	High	Poor	Poor	Good	Unsuitable.	Flooding	High water table.
Bedford (BdA, BdB, BdB2, BeA, BeB).	Poor to fair.	Medium	Fair	Fair	Good	Unsuitable.	Claypan	Seasonal high water table.
Brandywine (BfB2, BfC2, BfC3, BfD2, BfD3, BfE3).	Good	Low	Good	Good	Poor	Unsuitable.	Shallowness.	
Buchanan (BgB, BgB2, BhB, BhD).	Poor	Medium	Poor	Good	Fair	Suitable for stone.	(1)	Seasonal high water table.
Chester (CgA2, CgB, CgB2, CgB3, CgC, CgC2, CgC3, CgD, CgD2, CgD3, CgE, CgE2, CgE3, ChB, ChD, ChF.)	Good	Low	Good	Good	Fair	Suitable for stone.		
Comly (CmA, CmB, CmB2, CmC2)	Fair	Medium	Fair	Fair	Fair	Unsuitable.	Claypan	Seasonal high water table.
Croton (CrA, CrB, CsB)	Poor	High	Poor	Poor	Fair	Unsuitable.	Claypan	High water table.
Duffield (DuA2, DuB2, DuC2, DuD2, DuD3, DuE2, DuF2).	Fair	Low	Fair	Fair	Good	Suitable for stone.		
Duffield, low clay variant (DvA, DvA2, DvB, DvB2).	Fair	Low	Poor to fair	Fair	Good	Unsuitable.		
Elk (EkA)	Fair	Medium	Fair	Poor to fair	Good	Unsuitable.		
Extremely stony land (Es)	Fair	Low	Poor; little soil material.	Poor; little soil material.	Unsuitable.	Suitable for stone.		
Fleetwood (FgB2, FgC2, FgC3, FgD2, FgD3, FgE2, FhB, FhD, FhF).	Good	Low	Good	Good	Poor	Good		
Glenville (GnA, GnA2, GnB, GnB2, GnC, GnC2).	Fair	Medium	Fair	Fair	Fair	Unsuitable.	Claypan	Seasonal high water table.
Huntington (Hn)	Poor to fair.	Medium	Good below 3 feet, fair above.	Good below 3 feet, fair above.	Good	Unsuitable.	Flooding	Flooding

See footnote at end of table.

soils of Lehigh County for engineering construction

indicate that the soil generally has no special characteristics that interfere with the stated use]

Characteristics that affect—Continued		Characteristics that affect suitability for—							
Infiltration of effluent from septic tanks	Construction and maintenance of pipelines	Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building sites
			Reservoir area	Embankment					
High water table.	Stoniness	Stoniness		Stoniness	Stoniness	Shallowness to pan layer.	Stoniness	Stoniness	High water table.
Flooding and high water table.	Flooding and high water table.				Flooding	Wetness	Flooding	Wetness	Flooding and high water table.
Seasonal high water table; very slow permeability	Fluctuating water table.								Seasonal high water table; slow permeability.
Shallow to bedrock.	Shallow to bedrock.	Shallowness; rapid permeability.	Shallowness; rapid permeability.				Shallowness.	Shallowness.	Shallow to bedrock.
Seasonal high water table.	Fluctuating water table.	Stoniness		Stoniness	Stoniness		Stoniness	Stoniness	Seasonal high water table.
Very slow permeability; seasonal high water table.	Fluctuating water table.				Slow permeability.	Claypan			Seasonal high water table.
Very slow permeability; seasonal high water table.	High water table.				Slow permeability.	Shallowness to claypan.		Wetness; shallowness to claypan.	Seasonal high water table.
			Rapid permeability.						Sinks.
			Rapid permeability.	Instability.					Sinks.
			Rapid permeability.						
Unsuitable	Stoniness	Stoniness	Stoniness; rapid permeability.	Stoniness		Unsuitable.	Stoniness	Unsuitable	Stoniness.
	Stoniness		Rapid permeability.	Stoniness			Stoniness		
Seasonal high water table.	Fluctuating water table.								Seasonal high water table.
Flooding	Flooding						Flooding		Flooding.

TABLE 5.—*Suitability and characteristics of the soils of*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost heaving	Suitability of soil material for—		Suitability as source of—		Characteristics that affect—	
			Road subgrade	Road fill	Topsoil	Sand, gravel, and stone	Vertical alinement for highways	
							Materials	Drainage
Klinesville (KnB2, KnC2, KnD3, KnE3).	Good	Low	Good	Good	Fair	Unsuitable.		
Laidig (LaB2, LdB, LdD)	Good	Low	Good	Good	Poor	Suitable for stone.		
Lindside (Ln)	Poor	Medium	Fair	Fair	Good	Unsuitable.	Flooding	Flooding
Made land, granitic material (MaB, MaD).	Variable	Low	Good	Good	Unsuitable.	Unsuitable.		
Made land, limestone material (MeA, MeB, MeD).	Variable	Low	Fair	Fair	Unsuitable.	Unsuitable.		
Made land, shale material (MfB, MfD).	Variable	Low	Good	Good	Unsuitable.	Unsuitable.		
Melvin (Mh, MkA, MkB)	Very poor.	High	Poor	Poor	Good	Unsuitable.	Flooding	Flooding; high water table.
Monongahela (MlA, MlB2)	Poor	Medium to high.	Fair	Fair	Good	Unsuitable.	Fragipan.[1]	Seasonal high water table.
Montalto (MmB2, MmC2, MmC3, MmD2, MmD3, MmE3, MnB, MnD, MnE).	Fair	Medium	Poor to fair.	Fair	Fair	Suitable for stone.		
Montevallo (MoB2, MoC2, MoC3, MoD2, MoD3, MoE2, MoE3, MoF2, MoF3, MsD, MsF).	Good	Low	Poor to good; little soil material in places.	Poor to good; little soil material in places.	Poor	Unsuitable.		
Murrill (MuB2, MuC2, MuC3, MvB, MvD).	Good	Low	Good	Good	Good	Unsuitable.		
Norton (NtA, NtB2, NtC2, NtD2)	Good	Low	Fair	Good	Good	Unsuitable.		
Penn (PeB, PeB2, PeC2, PeC3, PeD2, PeD3, PeE2, PeE3).	Good	Low	Good	Good	Fair	Unsuitable.		
Philo (Ph)	Poor	High	Poor to fair.	Poor to fair.	Good	Unsuitable.	Flooding	Flooding
Readington (RdA, RdB, RdB2, RdC2).	Fair	Medium to high.	Fair	Fair	Good	Unsuitable.	Fragipan.[1]	Seasonal high water table.

See footnote at end of table.

Lehigh County for engineering construction—Continued

Characteristics that affect—Continued		Characteristics that affect suitability for—							
Infiltration of effluent from septic tanks	Construction and maintenance of pipelines	Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building sites
			Reservoir area	Embankment					
Shallowness to bedrock.	Shallowness.	Shallowness; rapid permeability.	Rapid permeability.	Rapid permeability.	----------	Shallowness.	----------	Shallowness.	Shallowness to bedrock.
----------	----------	Stoniness	----------	Stoniness	----------	----------	Stoniness	Stoniness	
Flooding	Flooding	----------	----------	----------	Flooding	----------	Flooding	----------	Flooding.
----------	----------	----------	Rapid permeability.	----------	----------	Variable	----------	----------	
----------	----------	----------	Rapid permeability.	----------	----------	Variable	----------	----------	
----------	----------	----------	Rapid permeability.	----------	----------	Variable	----------	----------	
Flooding; high water table.	Flooding; high water table.	----------	----------	----------	Flooding	Wetness	Flooding	Wetness	Flooding; high water table.
Slow permeability; high water table.	Fluctuating water table.	----------	----------	----------	----------	----------	----------	----------	Seasonal high water table.
----------	----------	----------	----------	Stoniness	----------	----------	----------	Stoniness	
Shallow to bedrock.	Shallow to bedrock.	Shallow; rapid permeability.	Shallow; rapid permeability.	Rapid permeability.	----------	Shallowness.	Shallowness.	Shallowness.	Shallow to bedrock.
----------	----------	Stoniness	Rapid permeability.	----------	----------	----------	Hummocky.	----------	Sinks.
Moderately slow permeability.	----------	----------	----------	----------	----------	----------	----------	----------	
Shallow to bedrock.	Shallow to bedrock.	Shallowness; rapid permeability.	Shallowness; rapid permeability.	----------	----------	----------	Shallowness.	Shallowness.	Shallow to bedrock.
Flooding	Flooding; fluctuating water table.	----------	----------	----------	Flooding	----------	Flooding	----------	Flooding.
Slow permeability; high water table.	Fluctuating water table.	----------	----------	----------	----------	----------	----------	----------	Seasonal high water table.

TABLE 5.—*Suitability and characteristics of the soils of*

Soil series and map symbols	Suitability for winter grading	Susceptibility to frost heaving	Suitability of soil material for—		Suitability as source of—		Characteristics that affect—	
			Road subgrade	Road fill	Topsoil	Sand, gravel, and stone	Vertical alinement for highways	
							Materials	Drainage
Riverwash (Rv)	Poor	High	Fair to good.	Good	Unsuitable.	Variable		Flooding
Ryder (RyA, RyB2, RyC2, RyC3, RyD3, RyE3).	Fair	Medium	Poor to fair	Poor to fair	Good	Unsuitable.		
Shelmadine (ShA, ShB, ShB2, ShC2).	Poor	High	Poor	Poor to fair	Good	Unsuitable.	Claypan	High water table.
Trexler (TrA, TrB2, TrB3, TrC2, TrC3, TrD2, TrD3, TsA2, TsB2, TsB3, TsC2, TsC3, TsD2, TsD3, TsE2, TsE3).	Good	Low	Good	Good	Good	Unsuitable.		
Washington gravelly loam, coarse variant (WcB2, WcC2).	Good	Low	Good	Good	Good	Fair		
Washington silt loam (WgA, WgA2, WgB, WgB2, WgC, WgC2, WgC3, WgD2).	Fair	Low to medium.	Fair	Poor to fair	Good	Unsuitable.		
Wheeling (WhA, WhB2, WhC2)	Good	Low	Good	Good	Good	Unsuitable.		
Woodglen (WoA, WoB, WrB)	Poor	High	Poor	Poor to fair	Fair	Unsuitable.	Claypan	High water table.
Worsham (WsA, WsA2, WsB, WsB2).	Poor	High	Poor	Poor	Fair	Unsuitable.	Claypan	High water table.

[1] Compact layers cause a high water table during wet periods.

Table 6 also gives compaction (moisture density) for the tested soils. If soil material is compacted at successively higher moisture contents, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is termed maximum dry density. Moisture-density data are important in earthwork, for, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Suitability of the soils for irrigation

The soil types of Lehigh County are grouped according to the suitability of the soils for irrigation. Not all of the groups in the statewide classification of soils for irrigation are represented in the county.

The qualities and characteristics most important in irrigation are rate of infiltration, permeability, depth, texture, drainage, and moisture-holding capacity. Slope, extent of previous erosion, and hazard of further erosion must be considered carefully in relation to individual sites. Steep or very stony soils, poorly drained soils, and most soils that have a fine-textured, slowly permeable subsoil have been omitted from the groups because they generally are unsuitable for irrigation.

The range of moisture-holding capacity assigned to the irrigation groups was made on a statewide basis for groups of soils. These groupings are more generalized than the estimates in engineering table 4; therefore, the values assigned to these soils do not all coincide.

IRRIGATION GROUP 1

In this group are deep, well drained and moderately well drained, permeable soils that are medium textured. These are residual and glaciated soils on uplands, and alluvial soils on flood plains and terraces. They are more than 36 inches deep. The following soils are in this group:

Chester gravelly silt loam.
Duffield silt loam.

Lehigh County for engineering construction—Continued

Characteristics that affect—Continued		Characteristics that affect suitability for—							
Infiltration of effluent from septic tanks	Construction and maintenance of pipelines	Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	Building sites
			Reservoir area	Embankment					
Unsuitable	Stoniness; shifting bedload.	Stoniness	Stoniness; rapid permeability.	Stoniness		Unsuitable.		Unsuitable	Frequent flooding.
			Rapid permeability.	Instability.					Sinks.
Very slow permeability; high water table.	High water table.				Slow permeability.	Shallow to claypan.		Shallow to claypan.	High water table.
			Rapid permeability.						Sinks.
			Rapid permeability.						Sinks.
			Rapid permeability.						
High water table; very slow permeability.	High water table.				Stoniness	Wetness		Wetness	High water table.
High water table.	High water table.					Wetness		Wetness	High water table.

Elk silt loam.
Fleetwood gravelly loam.
Huntington silt loam.
Lindside silt loam.
Norton silt loam.
Philo silt loam.
Trexler shaly silt loam.

The estimated available moisture-holding capacity of these soils is generally from 1.6 to 2.2 inches of water per foot of depth of soil. The maximum rate at which water should be applied for irrigation should be not more than 0.5 inch per hour on cultivated crops and 1.0 inch per hour on sod.

IRRIGATION GROUP 2

In this group are deep, well-drained, permeable soils that are medium textured to coarse textured. These soils are on uplands and terraces and in colluvial areas. They are more than 36 inches deep. The following soils are in this group:

Laidig gravelly loam.
Murrill gravelly loam.
Washington gravelly loam, coarse variant.
Wheeling gravelly loam.

Most of these soils have an estimated available moisture-holding capacity of 1.3 to 1.7 inches of water per foot of depth of soil. The maximum rate at which water should be applied for irrigation should be not more than 0.5 inch of water per hour on cultivated crops and 1.0 inch per hour on sod.

IRRIGATION GROUP 3

The soils in this group are deep, well-drained, permeable silt loams that have a heavy subsoil but good structure. These are residual and glaciated soils on uplands. They developed from limestone or diabase parent material and are more than 36 inches deep. The following soils are in this group:

Duffield silt loam, low clay variant.
Montalto silt loam.
Washington silt loam.

The estimated available moisture-holding capacity of these soils is mostly 2.0 to 2.3 inches of water per foot of depth of soil. Not more than 0.5 inch of water per hour should be applied for irrigation on cultivated soils, and not more than 1.0 inch of water per hour on sod.

TABLE 6.—*Engineering*

[Dashed lines indicate information

Name of soil and location	Parent material	Pennsylvania report no.	Depth	Horizon	Moisture-density [2]	
					Maximum dry density	Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Chester gravelly silt loam:						
2 miles S. of Vera Cruz and 2 miles E. of Old Zionsville. (Modal profile.)	Glaciated materials and gneiss (Reading Prong).	BE-17985	20-26	B_{22}	114	15
		BE-17986	37-50	C_1	121	12
0.5 mile SW. of Old Zionsville, Upper Milford Township. (Finer textured than the modal profile.)	Glaciated materials and gneiss (Reading Prong).	BE-23401	10-19	B_1	103	23
		BE-34202	37-50	C_1	112	17
2,000 feet NE. of intersection of roads T457 and 39081 in Salisbury Township. (Coarser textured than the modal profile.)	Glaciated materials and gneiss (Reading Prong).	BE-32278	16-25	B_{21}	115	12
		BE-32279	60-80+	C_2	120	11
Duffield silt loam, low clay variant:						
0.33 mile SE. of Fogelsville, Upper Macungie Township. (Modal profile.)	Shaly limestone.	BE-17546	20-27	B_{22}	102	21
		BE-17547	57-66	C_1	101	21
0.25 mile E. of Fogelsville and N. of the school on old U.S. 22 (Fine textured.)	Limestone.	BE-22761	27-39	B_{23} and B_{24}	100	17
		BE-22762	65-87+	C_1	97	23
0.75 mile E. of Newton, 425 feet E. of road T548 on road T511. (Coarse textured.)	Limestone.	BE-22759	18-28	B_{22}	101	17
		BE-22760	39-56+	C_1	104	17
Fleetwood stony loam:						
150 feet N. of intersection of roads T458 and T462. (Fine textured.)	Quartzite.	BE-32276	15-30	B_2	121	12
		BE-32277	40-50+	C_1	124	11
300 feet S. of road T422 and 2 miles S. of Vera Cruz. (Coarse textured.)	Quartzite and gneiss.	BE-32280	9-20	B_{21}	114	14
		BE-32281	36-48+	C_1	121	13
Montevallo channery silt loam:						
0.5 mile NE. of Siegersville, Heidelberg Township. (Modal profile.)	Glaciated gray shale (Martinsburg formation).	BE-17538	7-11	B_3	110	16
		BE-17539	16-24	C_2	116	15
0.5 mile NW. of Lyon Valley on road T658, Lowhill Township. (Fine textured.)	Glaciated gray shale (Martinsburg formation).	BE-23393	9-17	B_3	114	14
		BE-23394	17-35	C_1	116	14
300 feet W. of U.S. Route 309 on Lowhill Church Road, Lowhill Township. (Coarse textured.)	Glaciated gray shale (Martinsburg formation).	BE-22765	10-20	B_3	113	15
		BE-22766	20-60	C_1	117	14
Trexler shaly silt loam:						
0.5 mile NW. of Germansville, Heidelberg Township. (Modal profile.)	Pre-Wisconsin glacial till on Martinsburg shale.	BE-17542	16-22	B_{21}	113	16
		BE-17543	41-50	C_1	111	17
0.5 mile SE. of New Tripoli, Lynn Township. (Finer textured than the modal profile.)	Pre-Wisconsin glacial till on Martinsburg shale.	BE-32282	12-19	B_{21}	109	18
		BE-32283	36-40+	C_1	115	14
1 mile W. of Lyon Valley on road T658, Weisenberg Township. (Coarse textured.)	Glacial till.	BE-23395	16-38	B_2	117	14
		BE-23396	38-48+	C_1	120	12
Trexler shaly silt loam, moderately shallow:						
0.5 mile NW. of Germansville, Heidelberg Township. (Modal profile.)	Glaciated gray shale (Martinsburg formation).	BE-17540	11-19	B_{21}	112	16
		BE-17541	25-36	C_1	113	16
0.3 mile E. of road T788 along road T778 in Heidelberg Township. (Finer textured than the modal profile.)	Glaciated gray shale (Martinsburg formation).	BE-32272	18-33	B_{22}	112	16
		BE-32273	33-40	C_1	105	19
1 mile E. of Newside. (Coarser textured than the modal profile.)	Glaciated gray shale (Martinsburg formation).	BE-32270	12-25	B_3	114	14
		BE-32271	25-30+	C_1	116	13
Washington gravelly loam, coarse variant:						
1 mile N. of Siegersville and E. of the Turnpike in North Whitehall Township. (Modal profile.)	Pre-Wisconsin glacial materials.	BE-17544	15-22	B_{21}	112	17
		BE-17545	45-50	C_1	114	15

See footnotes at end of table.

test data [1]

not available or not applicable]

Mechanical analysis [3]												Liquid limit	Plasticity index	Classification	
Percentage passing sieve—								Percentage smaller than—							
2-in.	1½-in.	1-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [4]	Unified [5]
			100	95	86	68	52	50	36	23	18	35	10	A-4(3)	ML-CL.
			100	94	85	57	33	31	20	16	12	27	5	A-2-4(0)	SM-SC.
	100	97	94	91	88	78	58	55	41	30	21	44	10	A-5(5)	ML.
	100	88	88	80	73	57	29	27	16	11	7	35	4	A-2-4(0)	SM.
100	96	96	96	93	83	64	53	51	38	21	15	32	8	A-4(4)	ML-CL.
			100	99	78	62	34	31	24	13	7	28	2	A-2-4(0)	SM.
			100	99	98	96	93	91	72	45	31	43	15	A-7-6(11)	ML-CL.
		100	98	97	96	90	80	77	56	33	20	42	9	A-5(8)	ML.
			100	97	96	92	89	88	65	41	28	41	11	A-7-5(9)	ML.
		100	99	97	95	93	88	87	70	45	32	47	15	A-7-5(11)	ML.
		100	98	93	88	80	70	68	53	36	25	44	10	A-5(8)	ML.
	100	93	91	80	73	65	54	52	33	19	12	46	9	A-5(4)	ML.
	100	94	92	77	60	39	28	27	21	14	10	29	7	A-2-4(0)	SM-SC.
100	84	73	63	37	24	11	6	5	4	2	2	26	4	A-1-a(0)	GW-GC
86	81	64	60	45	39	31	24	23	18	12	8	30	4	A-1-b(0)	GM.
85	80	70	64	45	37	27	18	17	13	8	6	26	5	A-1-b(0)	GM-GC.
100	82	67	61	35	26	16	14	13	10	6	4	36	8	A-2-4(0)	GM.
100	88	72	63	26	16	7	6	5	4	3	2	32	7	A-2-4(0)	GW-GC.
	100	92	86	56	43	29	21	20	15	8	6	30	5	A-1-b(0)	GM.
	100	94	84	46	31	19	12	10	9	6	4	28	5	A-1-a(0)	GP-GC.
	100	99	95	36	23	15	13	12	10	7	3	35	9	A-2-4(0)	GM-GC.
		100	98	29	15	6	5	5	4	3	2	30	4	A-1-a(0)	GW-GM.
		100	98	83	73	62	53	51	42	26	18	31	9	A-4(4)	ML-CL.
	100	93	88	70	61	50	42	41	32	22	15	32	10	A-4 (1)	GM-GC.
		100	98	91	83	72	65	63	53	33	24	33	12	A-6(7)	CL.
	100	93	89	74	64	52	43	41	32	18	12	27	6	A-4(2)	SM-SC.
100	91	85	82	67	60	50	36	34	24	16	13	27	5	A-4(0)	GM-GC.
83	79	67	64	50	46	37	25	23	18	11	8	26	5	A-1-b(0)	GM-GC.
	100	92	82	50	40	28	23	22	18	13	10	34	10	A-2-4(0)	GM-GC.
100	90	84	69	40	35	28	22	21	16	8	5	29	4	A-1-b(0)	GM.
	100	93	86	68	61	51	40	38	29	18	14	29	7	A-4(1)	GM-GC.
85	74	69	59	43	38	31	26	25	21	15	13	36	11	A-2-6(0)	GM-GC.
	100	92	84	62	52	37	28	27	19	11	7	28	7	A-2-4(0)	GM-GC.
	100	95	93	62	53	37	30	28	19	7	4	24	2	A-2-4(0)	GM.
	100	86	80	54	45	34	28	27	24	17	11	34	9	A-2-4(0)	GM-GC.
	100	97	97	86	79	57	34	32	26	21	16	31	11	A-2-6(0)	SC.

TABLE 6.—*Engineering*

Name of soil and location	Parent material	Pennsylvania report no.	Depth	Horizon	Moisture-density [2]	
					Maximum dry density	Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
1 mile W. of Orefield, 0.25 mile S. of road T673 along road T674 in North Whitehall Township. (Finer textured than the modal profile.)	Pre-Wisconsin glacial materials.	BE–32274 BE–32275	42–60 60–72+	B_{22} C_1	113 108	13 18
1 mile N. of Siegersville in North Whitehall Township. (Coarser textured than the modal profile.)	Pre-Wisconsin glacial materials.	BE–23397 BE–23398	20–36 48–60+	B_2 C_1	112 116	14 13
Washington silt loam:						
0.5 mile NE. of Trexlertown, Upper Macungie Township. (Modal profile.)	Pre-Wisconsin glacial till.	BE–17983 BE–17984	17–27 37–46	B_{22} C_1	108 106	18 20
0.12 mile N. of road T483 and 2,000 feet E. of Route 229 in Lower Macungie Township. (Finer textured than the modal profile.)	Pre-Wisconsin glacial till.	BE–23399 BE–23400	25–37 54–60+	B_{23} C_1	107 106	18 18
Western edge of Kuhnsville, Upper Macungie Township. (Coarser textured than the modal profile.)	Pre-Wisconsin glacial till.	BE–22763 BE–22764	23–36 71–80+	B_{22} and B_{23} B_3 or C_1	117 108	13 17

[1] Tests performed by the Pennsylvania Department of Highways in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*).

[2] Moisture-density tests were performed by using Method A, AASHO Designation T 99–57.

[3] Mechanical analyses were done according to the AASHO Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter.

IRRIGATION GROUP 4

In this group are moderately well drained to somewhat poorly drained, medium-textured soils that are moderately deep over a fragipan or claypan. The initial permeability of these soils is generally moderate, but after they are saturated above the fragipan or claypan, the permeability is moderately slow to slow. Depth to the fragipan or claypan is 20 to 36 inches. These soils developed on glacial till, residuum, colluvium, and alluvium. The following soils are in this group:

Bedford silt loam.
Bedford and Lawrence silt loams.
Buchanan gravelly loam.
Comly silt loam.
Glenville silt loam.
Monongahela silt loam.
Readington silt loam.

The estimated available moisture-holding capacity of these soils is mostly from 1.8 to 2.2 inches of water per foot of depth of soil. The maximum rate at which water should be applied for irrigation should be not more than 0.5 inch per hour on cultivated soils and 1.0 inch per hour on sod.

IRRIGATION GROUP 5

In this group are moderately deep, well-drained, permeable soils that are medium textured. These are residual soils that are 20 to 36 inches deep over bedrock. The following soils are in this group:

Ryder silt loam.
Trexler shaly silt loam, moderately shallow.

The estimated available moisture-holding capacity of these soils is mostly from 1.8 to 2.2 inches of water per foot of depth of soil. The maximum rate at which water should be applied for irrigation is not more than 0.5 inch per hour on cultivated crops and 1.0 inch per hour on sod.

IRRIGATION GROUP 6

In this group are somewhat poorly drained to very poorly drained, slowly to very slowly permeable soils that are medium textured. These are residual, glacial, and colluvial soils. They are shallow to a hardpan or clay. The following soils are in this group:

Croton silt loam.
Shelmadine silt loam.

The estimated available moisture-holding capacity of these soils is mostly from 1.8 to 2.2 inches of water per foot of soil depth. The maximum rate at which water should be applied for irrigation should be not more than 0.2 inch per hour on cultivated crops and 0.3 inch per hour on sod. These soils generally are not suitable for irrigation.

test data [1]—Continued

Mechanical analysis [3]												Liquid limit	Plasticity index	Classification	
Percentage passing sieve—								Percentage smaller than—							
2-in.	1½-in.	1-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [4]	Unified [5]
100	93	88	87	77	71	54	34	31	25	19	16	29	10	A-2-4(0)	SC.
81	73	64	61	40	32	21	17	16	12	11	10	46	16	A-2-7(0)	GM.
-------	100	98	98	88	77	31	25	24	20	20	19	47	18	A-2-7(1)	SM-SC.
84	74	69	66	39	24	7	4	4	3	2	2	34	10	A-2-4(0)	GW.
-------	-------	------	100	95	91	84	77	76	62	45	39	41	16	A-7-6(11)	ML-CL.
-------	-------	------	------	98	96	93	88	86	66	46	38	37	12	A-6(9)	ML-CL.
-------	-------	------	100	98	95	88	76	74	59	47	40	36	13	A-6(9)	ML-CL.
-------	100	90	90	84	82	78	72	70	59	46	36	40	6	A-4(7)	ML.
-------	100	94	88	79	73	64	56	54	36	20	15	26	5	A-4(4)	ML-CL.
-------	-------	100	99	95	92	87	79	78	62	43	32	35	11	A-6(8)	ML-CL.

In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming the textural classes of soils.

[4] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145–49.

[5] Based on the Unified Soil Classification System, Tech. Memo. No. 3–357, v. 1, Waterways Expt. Sta., Corps of Engin., March 1953 (*23*).

IRRIGATION GROUP 7

In this group are shallow to moderately deep, well-drained, permeable soils that are medium textured. These are residual and glaciated upland soils. They are 10 to 20 inches deep over weathered or shattered bedrock. The following soils are in this group:

Brandywine loam.
Klinesville shaly silt loam.
Montevallo channery silt loam.
Penn shaly silt loam.

The estimated available moisture-holding capacity of these soils is mostly from 1.6 to 2.4 inches per foot of soil. The maximum rate at which water should be applied for irrigation is 0.5 inch per hour on cultivated crops and 1.0 inches per hour on sod.

Soils and suburban developments

In Lehigh County the population is increasing rapidly and the suburbs of Allentown and Bethlehem are expanding into areas that formerly were rural. Typically, these areas are beyond the expanding suburbs and contain groups of homes scattered among patches of farmland. This section is designed to aid planning officials, realtors, and others interested in residential use of these expanding areas.

The soils of the county have been placed in groups for building sites on the basis of their characteristics that affect use for suburban or residential construction. The main characteristics considered are depth of the soil, degree of slope, internal drainage, freedom from flooding, kind of parent material, and stoniness. The soils in any one group are much alike in those characteristics that affect their suitability as sites for homesites and community developments. Each group is described in terms of its characteristics and its suitability for suburban use.

The grouping of soils for building sites, with information given in tables and maps provided elsewhere in this report, will aid those seeking suitable sites. The groupings, however, are not a substitute for the detailed investigation needed at the site proposed for an expensive development. Also, the groupings take into account only the characteristics of the soils. Not considered are distance to established centers, transportation lines, and other economic factors. Groupings of soils for building sites are made for this special purpose and are likely to differ from groupings of soils for agriculture or forestry; that is, capability units, woodland groups, or irrigation groups.

GROUP 1 FOR BUILDING SITES

These are deep, well-drained, permeable soils that have slopes of 0 to 8 percent. The following soils are in this group:

Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded.
Chester gravelly silt loam, 3 to 8 percent slopes.
Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded.
Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded.
Duffield silt loam, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, 3 to 8 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 0 to 3 percent slopes.
Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded.
Duffield silt loam, low clay variant, 3 to 8 percent slopes.
Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded.
Elk silt loam, 0 to 3 percent slopes.
Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded.
Made land, granitic material, 0 to 8 percent slopes.
Made land, limestone material, 0 to 3 percent slopes.
Made land, limestone material, 3 to 8 percent slopes.
Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded.
Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded.
Washington silt loam, 0 to 3 percent slopes.
Washington silt loam, 0 to 3 percent slopes, moderately eroded.
Washington silt loam, 3 to 8 percent slopes.
Washington silt loam, 3 to 8 percent slopes, moderately eroded.
Wheeling gravelly loam, 0 to 3 percent slopes.
Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded.

The soils in this group have few natural limitations, are easily cultivated, and are among the best for agriculture in the county. Except for the units of Made land, these soils are better used for agriculture than for homes or other buildings. If they are selected as building sites, their mild slopes and ease of grading make them desirable locations for stores, factories, schools, and hospitals.

Some areas of Duffield and Washington soils are not suitable for foundations, because of solution caverns in the underlying bedrock. The other soils are generally suitable, but each potential building site ought to be examined carefully.

These soils are generally suitable as fields for septic tanks because they have good permeability, are not affected by a seasonal high water table, and absorb effluent from septic tanks fairly rapidly. If a large amount of waste liquid soaks into the soils underlain by limestone, however, the ground water is likely to be contaminated because the bedrock under these soils has large channels and caverns.

GROUP 2 FOR BUILDING SITES

These are deep, well-drained, permeable soils that have slopes of 8 to 25 percent. The following soils are in this group:

Chester gravelly silt loam, 8 to 15 percent slopes.
Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded.
Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded.
Chester gravelly silt loam, 15 to 25 percent slopes.
Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded.
Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded.
Duffield silt loam, 8 to 15 percent slopes, moderately eroded.
Duffield silt loam, 15 to 25 percent slopes, moderately eroded.
Duffield silt loam, 15 to 25 percent slopes, severely eroded.
Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded.
Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded.
Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded.
Made land, granitic material, 8 to 25 percent slopes.
Made land, limestone material, 8 to 25 percent slopes.
Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded.
Murrill gravelly loam, 8 to 15 percent slopes, severely eroded.
Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded.
Washington silt loam, 8 to 15 percent slopes.
Washington silt loam, 8 to 15 percent slopes, moderately eroded.
Washington silt loam, 8 to 15 percent slopes, severely eroded.
Washington silt loam, 15 to 25 percent slopes, moderately eroded.
Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded.

These soils have slopes that are satisfactory for residences, but they are somewhat steep for large stores, factories, schools, or hospitals. Most areas are suitable for foundations, but there is some slow soil creep on the steeper slopes.

The soils in this group have good surface drainage and are free of a seasonal high water table. If they are used for residential developments, runoff and gully erosion may be problems.

The soils will absorb a normal load of effluent from septic tanks. If large amounts of effluent soaks into the Duffield and Washington soils, however, the ground water is likely to be contaminated because the bedrock under these soils has large channels.

GROUP 3 FOR BUILDING SITES

These are deep, well-drained, slowly to moderately permeable soils that have slopes of 0 to 8 percent. The following soils are in this group:

Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded.
Laidig very stony loam, 0 to 8 percent slopes.
Montalto silt loam, 3 to 8 percent slopes, moderately eroded.
Montalto very stony loam, 0 to 8 percent slopes.
Norton silt loam, 0 to 3 percent slopes.
Norton silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, 0 to 3 percent slopes.
Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded.

Except for the very stony Montalto and Laidig soils, the soils of this group are well suited to the kinds of crops commonly grown in this county. Their use for that purpose, rather than for construction, should be considered.

All of these soils have slopes that are favorable for stores, factories, and schools. If the very stony Laidig and Montalto soils are used for construction, however, the many boulders will add to the cost of excavating and grading.

These soils do not have a seasonal high water table. They are porous enough so that drainage and aeration are good.

These soils absorb waste materials less rapidly than the soils of groups 1 and 2. Therefore, larger disposal fields will be required if septic tanks are to operate satisfactorily.

GROUP 4 FOR BUILDING SITES

These are deep, well-drained, slowly permeable soils that have slopes of 8 to 25 percent. The following soils are in this group:

Laidig very stony loam, 8 to 25 percent slopes.
Montalto silt loam, 8 to 15 percent slopes, moderately eroded.
Montalto silt loam, 8 to 15 percent slopes, severely eroded.
Montalto silt loam, 15 to 25 percent slopes, moderately eroded.
Montalto silt loam, 15 to 25 percent slopes, severely eroded.
Montalto very stony loam, 8 to 25 percent slopes.
Norton silt loam, 8 to 15 percent slopes, moderately eroded.
Norton silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded.

The soils in this group have slopes satisfactory for residences, but they are somewhat steep for the large buildings and grounds needed for stores, factories, schools, or hospitals. The soils generally are good for foundations, but some slow soil creep occurs on the steeper slopes.

The very stony Montalto and Laidig soils contain boulders that increase the cost and difficulty of excavating and grading. If the soils in this group are not protected during and after construction, severe erosion may take place and nearby lower areas may be flooded and covered by deposits of sediment.

These soils do not have a seasonal high water table. They have good internal drainage and are well aerated, but they absorb effluent from septic tanks more slowly than the soils of groups 1 and 2. Therefore, if these soils are used as fields for septic tanks, the fields must be larger than for the soils of groups 1 and 2.

GROUP 5 FOR BUILDING SITES

These are predominantly moderately deep, well-drained, permeable soils that have slopes of 0 to 8 percent. The following soils are in this group:

Chester very stony silt loam, 0 to 8 percent slopes.
Fleetwood very stony loam, 0 to 8 percent slopes.
Made land, shale material, 0 to 8 percent slopes.
Murrill very stony loam, 0 to 8 percent slopes.
Ryder silt loam, 0 to 3 percent slopes.
Ryder silt loam, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded.

Except for the very stony soils and the unit of Made land, the soils of this group are fairly good for agriculture. Their slopes are favorable for stores, factories, schools, and similar large structures. If the very stony soils are used for construction, the boulders will increase the cost of excavating and grading.

Most areas of these soils are suitable for foundations, but bedrock is only 2 to 4 feet below the surface in most places. The upper part of the bedrock is partially weathered and soft, and in many places bedrock of varying hardness is reached in excavating. In many places the Chester soil is underlain by saprolite, or rotten rock, to a depth of 20 or more feet. This rotten rock is not stable under heavy weight. Because the soils in this group are well-drained and permeable, they readily absorb wastes and are suitable fields for septic tanks.

GROUP 6 FOR BUILDING SITES

These are moderately deep, well-drained, permeable soils that have slopes of 8 to 25 percent. The following soils are in this group:

Chester very stony silt loam, 8 to 25 percent slopes.
Fleetwood very stony loam, 8 to 25 percent slopes.
Made land, shale material, 8 to 25 percent slopes.
Murrill very stony loam, 8 to 25 percent slopes.
Ryder silt loam, 8 to 15 percent slopes, moderately eroded.
Ryder silt loam, 8 to 15 percent slopes, severely eroded.
Ryder silt loam, 15 to 25 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded.

These soils have slopes satisfactory for residences, but they are too steep for large stores, factories, schools, or other buildings that require ready access. The soils are fairly suitable as foundations for small structures.

Boulders scattered throughout the very stony soils and the underlying material make excavation and grading somewhat difficult and expensive on these soils. The partly weathered rock underlying the Chester soil is soft and somewhat elastic in many places. On steep slopes there is slow soil creep. While construction is taking place, surface runoff is a problem, and it may cause severe gullying.

These soils do not have a seasonal high water table. They have good internal drainage and are well aerated. Effluent from septic tanks soaks in satisfactorily, and the soils are, therefore, suitable as fields for septic tanks.

GROUP 7 FOR BUILDING SITES

These are shallow, well-drained soils that have slopes of 3 to 8 percent. The following soils are in this group:

Brandywine loam, 3 to 8 percent slopes, moderately eroded.
Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded.
Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded.
Penn shaly silt loam, 3 to 8 percent slopes.
Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded.

These soils are shallow over bedrock. The bedrock is generally hard enough that the soils are suitable for foundations. The areas are generally too small for shopping centers, factories, schools, or similar construction.

Excavating in soils of this group usually requires that the bedrock be quarried to some extent. The material that remains after earthmoving is completed generally contains too many fragments of broken rock or is too shallow to be suitable for growing grass, shrubs, or trees. Also, the soil material is droughty, and difficulty can be expected in revegetating the areas and in establishing a good lawn.

Although these soils are well drained and are well aerated, they are permeable to a depth of only 1 or 2 feet. Bedrock below that depth prevents water from soaking in. Every site should be tested carefully to make sure that water that has been added does not build up to saturate the entire soil and then come to the surface. Difficulty can be expected if the soils are used as fields for septic tanks. If waste from septic tanks were to sink into cracks in the bedrock, it might contaminate the ground water, because the soil material makes a poor filter.

GROUP 8 FOR BUILDING SITES

These are shallow, well-drained soils that have slopes of 8 to 25 percent. The following soils are in this group:

Brandywine loam, 8 to 15 percent slopes, moderately eroded.
Brandywine loam, 8 to 15 percent slopes, severely eroded.
Brandywine loam, 15 to 25 percent slopes, moderately eroded.
Brandywine loam, 15 to 25 percent slopes, severely eroded.
Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded.
Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded.
Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded.
Montevallo very rocky silt loam, 8 to 25 percent slopes.
Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded.
Penn shaly silt loam, 8 to 15 percent slopes, severely eroded.
Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded.
Penn shaly silt loam, 15 to 25 percent slopes, severely eroded.

The soils in this group have slopes that are satisfactory for residences. They are too steep for shopping centers, factories, or similar large commercial, industrial, or institutional construction. In most of the soils, bedrock is at a depth of 1 to 2 feet. The bedrock below most of the soils is hard enough to be satisfactory for foundations, but the bedrock underlying the Brandywine soils is soft in places.

Generally, excavating in these soils requires some quarrying of the bedrock. If the stony soils are used for construction, the large number of boulders will increase the cost of grading. On the steeper slopes there is some slow soil creep.

In many places runoff and the resulting erosion are problems during construction. If earthmoving is necessary, the soils are so shallow that the soil material left is poor for growing grass, shrubs, or trees. Droughtiness makes it hard to establish good lawns and vigorous shrubs.

Although these soils are well drained and do not have a seasonal high water table, the bedrock near the surface may cause lateral seepage. If water is added, as in areas used as fields for septic tanks, the water is likely to seep out on the hillsides farther down the slope.

GROUP 9 FOR BUILDING SITES

These are well-drained soils that have slopes steeper than 25 percent. The following soils are in this group:

Brandywine loam, 25 to 35 percent slopes, severely eroded.
Chester gravelly silt loam, 25 to 35 percent slopes.
Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded.
Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded.
Chester very stony silt loam, 25 to 50 percent slopes.
Duffield silt loam, 25 to 35 percent slopes, moderately eroded.
Duffield silt loam, 35 to 55 percent slopes, moderately eroded.
Extremely stony land.
Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded.
Fleetwood very stony loam, 25 to 60 percent slopes.
Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded.
Montalto silt loam, 25 to 35 percent slopes, severely eroded.
Montalto very stony loam, 25 to 35 percent slopes.
Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded.
Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded.
Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded.
Montevallo very rocky silt loam, 25 to 65 percent slopes.
Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded.
Penn shaly silt loam, 25 to 40 percent slopes, severely eroded.
Ryder silt loam, 25 to 35 percent slopes, severely eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded.
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded.

These soils are too steep to be used for ordinary dwellings. In rural areas they can best be used as open spaces, or for parks or forests. Some areas may be suitable for use as extensive pastures or game preserves.

In many places these soils occur in areas where the view is unobstructed. Therefore, use of large tracts for luxury housing may be feasible. If the soils are used for that purpose, each site needs to be examined carefully to see that it is suitable for construction.

GROUP 10 FOR BUILDING SITES

These are deep, moderately well drained to somewhat poorly drained soils that have slopes of 0 to 8 percent. The following soils are in this group:

Bedford silt loam, 0 to 3 percent slopes.
Bedford silt loam, 3 to 8 percent slopes.
Bedford silt loam, 3 to 8 percent slopes, moderately eroded.
Buchanan gravelly loam, 3 to 8 percent slopes.
Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded.
Buchanan very stony loam, 0 to 8 percent slopes.
Comly silt loam, 0 to 3 percent slopes.
Comly silt loam, 3 to 8 percent slopes.
Comly silt loam, 3 to 8 percent slopes, moderately eroded.
Glenville silt loam, 0 to 3 percent slopes.
Glenville silt loam, 0 to 3 percent slopes, moderately eroded.
Glenville silt loam, 3 to 8 percent slopes.
Glenville silt loam, 3 to 8 percent slopes, moderately eroded.
Monongahela silt loam, 0 to 3 percent slopes.
Monongahela silt loam, 3 to 8 percent slopes, moderately eroded.
Readington silt loam, 0 to 3 percent slopes.
Readington silt loam, 3 to 8 percent slopes.
Readington silt loam, 3 to 8 percent slopes, moderately eroded.

These soils have a seasonal high water table that persists for several weeks in most years. The high water table causes sealing and drainage problems in basements. The soils have gentle slopes that are favorable for stores, factories, schools, and similar commercial, industrial, and institutional construction. Satisfactory foundations are usually possible on these soils. The boulders in the very

stony Buchanan soil add to the cost of excavating and grading.

If these soils are used as fields for septic tanks, the water table will be too high for several weeks each year, and effluent will not be absorbed properly. In some of the more permeable soils, such as the Glenville and Bedford soils, absorption can be improved if an independent tile drainage system that has an adequate outlet is installed before the septic-tank disposal field is established. For seasonal use in summer, as for a summer camp, these soils may be used satisfactorily as fields for septic tanks, but the fields need to be large.

GROUP 11 FOR BUILDING SITES

These are deep, moderately well drained soils that have slopes of 8 to 25 percent. The following soils are in this group:

Buchanan very stony loam, 8 to 25 percent slopes.
Comly silt loam, 8 to 15 percent slopes, moderately eroded.
Glenville silt loam, 8 to 15 percent slopes.
Glenville silt loam, 8 to 15 percent slopes, moderately eroded.
Readington silt loam, 8 to 15 percent slopes, moderately eroded.

These soils have moderately good internal drainage, but they have a seasonally high water table, and there is seepage on the hillsides. They are satisfactory as foundations for houses, but there are problems in sealing and draining the basements. The boulders in the very stony Buchanan soil increase the difficulty of excavating and grading.

Seepage through the subsoil, when there is a seasonal high water table, makes these soils poor as fields for septic tanks. If much waste is added to the septic-tank system, it may seep out on the surface farther down the slope.

GROUP 12 FOR BUILDING SITES

These are poorly drained and somewhat poorly drained soils of uplands that have slopes of 0 to 15 percent. The following soils are in this group:

Andover very stony sandy loam, 0 to 8 percent slopes.
Bedford and Lawrence silt loams, 0 to 3 percent slopes.
Bedford and Lawrence silt loams, 3 to 8 percent slopes.
Croton silt loam, 0 to 3 percent slopes.
Croton silt loam, 3 to 8 percent slopes.
Croton very stony loam, 0 to 8 percent slopes.
Melvin silt loam, local alluvium, 0 to 3 percent slopes.
Melvin silt loam, local alluvium, 3 to 8 percent slopes.
Shelmadine silt loam, 0 to 3 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes.
Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded.
Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded.
Woodglen silt loam, 0 to 3 percent slopes.
Woodglen silt loam, 3 to 8 percent slopes.
Woodglen very stony silt loam, 0 to 8 percent slopes.
Worsham silt loam, 0 to 3 percent slopes.
Worsham silt loam, 0 to 3 percent slopes, moderately eroded.
Worsham silt loam, 3 to 8 percent slopes.
Worsham silt loam, 3 to 8 percent slopes, moderately eroded.

These soils have a high water table during most of the year, and at times water stands on the surface. The soils are generally unsatisfactory for heavy structures. If they are used for commercial or residential construction, fill will be needed to raise floors above the level reached by the water table. The fill ought to be adequately drained so that the water table will not rise to the new level.

These soils are not suitable as fields for septic tanks. If they are used for that purpose, distribution lines would be below the level of the normal water table for long periods.

GROUP 13 FOR BUILDING SITES

These are soils of flood plains that are subject to overflow. The following soils are in this group:

Atkins silt loam.
Atkins silt loam, local alluvium, 0 to 3 percent slopes.
Huntington silt loam.
Lindside silt loam.
Melvin silt loam.
Philo silt loam.
Riverwash.

These soils are subject to flooding, and they are not suitable as sites for buildings. Some areas may have value as parks and recreational areas, and some may be used for agriculture.

Descriptions of the Soils

This section is provided for those who want detailed information about the soils in the county. It describes the individual soils, or mapping units; that is, the areas on the detailed soil map that are bounded by lines and are identified by a symbol. For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. The approximate acreage and proportionate extent of each soil mapped in the county are given in table 7, and their location is shown on the soil map at the back of the report. Terms used to describe the soils are given in the Glossary.

In the descriptions that follow, each soil series is first described, and then the soils in the series. The series description mentions features that apply to all of the soils it contains.

Only one soil profile is described in detail for each series, and that profile is described under the description of the series. The profile described is considered to be representative for all the soils in the series. The descriptions of the soils in the series generally tell how their profile differs from the one given as representative of the series.

In describing the profile a letter symbol, for example, "A_1", was assigned to each of the various horizons, or layers. These letter symbols have a special meaning for soil scientists and others who make detailed studies of the soils. Most readers will need to remember only that all of the letter symbols beginning with "A" are the surface layer; those beginning with "B" are the subsoil; those beginning with "C" are the substratum, or parent material; and those beginning with "D" are bedrock.

The color of each horizon is described in words, such as yellowish brown, but it can also be indicated by symbols for the hue, value, and chroma, such as 10YR 5/4. These symbols, called Munsell color notations (*20*), are used by soil scientists to evaluate the color of the soil precisely. For the profiles described, the names of the colors and the color symbols are for moist soil unless stated otherwise.

The boundaries between horizons are described so as to indicate their thickness and shape. The terms for thickness are *abrupt*, *clear*, *gradual*, and *diffuse*. The shape of the boundary is described as *smooth*, *wavy*, *irregular*, or *broken*.

TABLE 7.—*Approximate acreage and proportionate extent of the soils mapped*

Soils	Acres	Percent
Andover very stony sandy loam, 0 to 8 percent slopes	1, 207	0. 5
Atkins silt loam	5, 065	2. 3
Atkins silt loam, local alluvium, 0 to 3 percent slopes	132	. 1
Bedford silt loam, 0 to 3 percent slopes	1, 664	. 7
Bedford silt loam, 3 to 8 percent slopes	509	. 2
Bedford silt loam, 3 to 8 percent slopes, moderately eroded	427	. 2
Bedford and Lawrence silt loams, 0 to 3 percent slopes	101	(1)
Bedford and Lawrence silt loams, 3 to 8 percent slopes	105	(1)
Brandywine loam, 3 to 8 percent slopes, moderately eroded	99	(1)
Brandywine loam, 8 to 15 percent slopes, moderately eroded	300	. 1
Brandywine loam, 8 to 15 percent slopes, severely eroded	51	(1)
Brandywine loam, 15 to 25 percent slopes, moderately eroded	126	. 1
Brandywine loam, 15 to 25 percent slopes, severely eroded	136	. 1
Brandywine loam, 25 to 35 percent slopes, severely eroded	48	(1)
Buchanan gravelly loam, 3 to 8 percent slopes	280	. 1
Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded	174	. 1
Buchanan very stony loam, 0 to 8 percent slopes	1, 386	. 6
Buchanan very stony loam, 8 to 25 percent slopes	207	. 1
Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded	345	. 2
Chester gravelly silt loam, 3 to 8 percent slopes	253	. 1
Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded	4, 310	1. 9
Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded	362	. 2
Chester gravelly silt loam, 8 to 15 percent slopes	189	. 1
Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded	3, 100	1. 4
Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded	1, 100	. 5
Chester gravelly silt loam, 15 to 25 percent slopes	67	(1)
Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded	468	. 2
Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded	970	. 4
Chester gravelly silt loam, 25 to 35 percent slopes	27	(1)
Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded	58	(1)
Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded	161	. 1
Chester very stony silt loam, 0 to 8 percent slopes	1, 029	. 5
Chester very stony silt loam, 8 to 25 percent slopes	4, 640	2. 1
Chester very stony silt loam, 25 to 50 percent slopes	2, 664	1. 2
Comly silt loam, 0 to 3 percent slopes	708	. 3
Comly silt loam, 3 to 8 percent slopes	1, 305	. 6
Comly silt loam, 3 to 8 percent slopes, moderately eroded	1, 681	. 8
Comly silt loam, 8 to 15 percent slopes, moderately eroded	159	. 1
Croton silt loam, 0 to 3 percent slopes	188	. 1
Croton silt loam, 3 to 8 percent slopes	225	. 1
Croton very stony loam, 0 to 8 percent slopes	94	(1)
Duffield silt loam, 0 to 3 percent slopes, moderately eroded	241	. 1
Duffield silt loam, 3 to 8 percent slopes, moderately eroded	2, 641	1. 2
Duffield silt loam, 8 to 15 percent slopes, moderately eroded	1, 069	. 5
Duffield silt loam, 15 to 25 percent slopes, moderately eroded	173	0. 1
Duffield silt loam, 15 to 25 percent slopes, severely eroded	247	. 1
Duffield silt loam, 25 to 35 percent slopes, moderately eroded	79	(1)
Duffield silt loam, 35 to 55 percent slopes, moderately eroded	121	. 1
Duffield silt loam, low clay variant, 0 to 3 percent slopes	411	. 2
Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded	226	. 1
Duffield silt loam, low clay variant, 3 to 8 percent slopes	111	(1)
Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded	1, 078	. 5
Elk silt loam, 0 to 3 percent slopes	180	. 1
Extremely stony land	2, 051	. 9
Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded	645	. 3
Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded	615	. 3
Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded	281	. 1
Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded	93	(1)
Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded	104	(1)
Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded	42	(1)
Fleetwood very stony loam, 0 to 8 percent slopes	457	. 2
Fleetwood very stony loam, 8 to 25 percent slopes	1, 794	. 8
Fleetwood very stony loam, 25 to 60 percent slopes	486	. 2
Glenville silt loam, 0 to 3 percent slopes	106	(1)
Glenville silt loam, 0 to 3 percent slopes, moderately eroded	68	(1)
Glenville silt loam, 3 to 8 percent slopes	244	. 1
Glenville silt loam, 3 to 8 percent slopes, moderately eroded	977	. 4
Glenville silt loam, 8 to 15 percent slopes	14	(1)
Glenville silt loam, 8 to 15 percent slopes, moderately eroded	210	. 1
Huntington silt loam	626	. 3
Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded	63	(1)
Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded	24	(1)
Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded	26	(1)
Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded	34	(1)
Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded	303	. 1
Laidig very stony loam, 0 to 8 percent slopes	1, 958	. 9
Laidig very stony loam, 8 to 25 percent slopes	4, 058	1. 8
Lindside silt loam	1, 606	. 7
Made land, granitic material, 0 to 8 percent slopes	54	(1)
Made land, granitic material, 8 to 25 percent slopes	6	(1)
Made land, limestone material, 0 to 3 percent slopes	3, 647	1. 6
Made land, limestone material, 3 to 8 percent slopes	5, 137	2. 3
Made land, limestone material, 8 to 25 percent slopes	1, 684	. 8
Made land, shale material, 0 to 8 percent slopes	289	. 1
Made land, shale material, 8 to 25 percent slopes	414	. 2
Melvin silt loam	1, 213	. 5
Melvin silt loam, local alluvium, 0 to 3 percent slopes	908	. 4

See footnote at end of table.

TABLE 7.—*Approximate acreage and proportionate extent of the soils mapped*—Continued

Soils	Acres	Percent
Melvin silt loam, local alluvium, 3 to 8 percent slopes	281	0.1
Monongahela silt loam, 0 to 3 percent slopes	96	(1)
Monongahela silt loam, 3 to 8 percent slopes, moderately eroded	147	.1
Montalto silt loam, 3 to 8 percent slopes, moderately eroded	1,104	.5
Montalto silt loam, 8 to 15 percent slopes, moderately eroded	875	.4
Montalto silt loam, 8 to 15 percent slopes, severely eroded	252	.1
Montalto silt loam, 15 to 25 percent slopes, moderately eroded	59	(1)
Montalto silt loam, 15 to 25 percent slopes, severely eroded	205	.1
Montalto silt loam, 25 to 35 percent slopes, severely eroded	57	(1)
Montalto very stony loam, 0 to 8 percent slopes	311	.1
Montalto very stony loam, 8 to 25 percent slopes	815	.4
Montalto very stony loam, 25 to 35 percent slopes	287	.1
Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded	470	.2
Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded	461	.2
Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded	249	.1
Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded	736	.3
Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded	928	.4
Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded	391	.2
Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded	1,121	.5
Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded	2,387	1.1
Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded	1,259	.6
Montevallo very rocky silt loam, 8 to 25 percent slopes	29	(1)
Montevallo very rocky silt loam, 25 to 65 percent slopes	73	(1)
Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded	979	.4
Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded	618	.3
Murrill gravelly loam, 8 to 15 percent slopes, severely eroded	150	.1
Murrill very stony loam, 0 to 8 percent slopes	30	(1)
Murrill very stony loam, 8 to 25 percent slopes	77	(1)
Norton silt loam, 0 to 3 percent slopes	297	.1
Norton silt loam, 3 to 8 percent slopes, moderately eroded	2,737	1.2
Norton silt loam, 8 to 15 percent slopes, moderately eroded	360	.2
Norton silt loam, 15 to 25 percent slopes, moderately eroded	130	.1
Penn shaly silt loam, 3 to 8 percent slopes	181	.1
Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded	602	.3
Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded	370	.2
Penn shaly silt loam, 8 to 15 percent slopes, severely eroded	592	.3
Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded	287	.1
Penn shaly silt loam, 15 to 25 percent slopes, severely eroded	431	.2
Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded	119	.1
Penn shaly silt loam, 25 to 40 percent slopes, severely eroded	90	(1)
Philo silt loam	999	0.4
Readington silt loam, 0 to 3 percent slopes	168	.1
Readington silt loam, 3 to 8 percent slopes	55	(1)
Readington silt loam, 3 to 8 percent slopes, moderately eroded	340	.2
Readington silt loam, 8 to 15 percent slopes, moderately eroded	39	(1)
Riverwash	188	.1
Ryder silt loam, 0 to 3 percent slopes	269	.1
Ryder silt loam, 3 to 8 percent slopes, moderately eroded	1,311	.6
Ryder silt loam, 8 to 15 percent slopes, moderately eroded	433	.2
Ryder silt loam, 8 to 15 percent slopes, severely eroded	59	(1)
Ryder silt loam, 15 to 25 percent slopes, severely eroded	72	(1)
Ryder silt loam, 25 to 35 percent slopes, severely eroded	16	(1)
Shelmadine silt loam, 0 to 3 percent slopes	1,812	.8
Shelmadine silt loam, 3 to 8 percent slopes	1,546	.7
Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded	1,097	.5
Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded	77	(1)
Trexler shaly silt loam, 0 to 3 percent slopes	1,216	.5
Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded	7,039	3.2
Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded	167	.1
Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded	2,574	1.2
Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded	290	.1
Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded	1,113	.5
Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded	94	(1)
Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded	1,861	.8
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded	19,514	8.8
Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded	1,256	.6
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded	11,834	5.3
Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded	4,704	2.1
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded	4,469	2.0
Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded	6,854	3.1
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded	2,942	1.3
Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded	3,688	1.7
Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded	1,048	.5
Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded	361	.2
Washington silt loam, 0 to 3 percent slopes	2,668	1.2
Washington silt loam, 0 to 3 percent slopes, moderately eroded	8,775	3.9
Washington silt loam, 3 to 8 percent slopes	833	.4
Washington silt loam, 3 to 8 percent slopes, moderately eroded	28,644	12.9
Washington silt loam, 8 to 15 percent slopes	102	(1)
Washington silt loam, 8 to 15 percent slopes, moderately eroded	2,575	1.1
Washington silt loam, 8 to 15 percent slopes, severely eroded	1,303	.6

See footnote at end of table.

TABLE 7.—*Approximate acreage and proportionate extent of the soils mapped*—Continued

Soils	Acres	Percent	Soils	Acres	Percent
Washington silt loam, 15 to 25 percent slopes, moderately eroded	576	0.3	Worsham silt loam, 0 to 3 percent slopes	343	0.2
Wheeling gravelly loam, 0 to 3 percent slopes	37	(1)	Worsham silt loam, 0 to 3 percent slopes, moderately eroded	57	(1)
Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded	274	.1	Worsham silt loam, 3 to 8 percent slopes	346	.2
Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded	23	(1)	Worsham silt loam, 3 to 8 percent slopes, moderately eroded	339	.2
Woodglen silt loam, 0 to 3 percent slopes	85	(1)	Mines and pits	1,398	.6
Woodglen silt loam, 3 to 8 percent slopes	278	.1	Water	640	.3
Woodglen very stony silt loam, 0 to 8 percent slopes	342	.2	Total	222,720	100.0

[1] Less than 0.1 percent.

Andover Series

The Andover series consists of poorly drained soils that are along the lower slopes of Blue Mountain. The soils formed in colluvial material that washed or rolled from higher areas underlain by sandstone, conglomerate, and quartzite. They are in low places and along drainageways where water collects as the result of seepage.

These soils have 1 to 2 inches of black, organic material that overlies a dark-gray surface layer. Their subsoil is grayish and is mottled with brown and reddish yellow. Scattered on the surface are cobbles and boulders of sandstone and conglomerate that range from a few inches to several feet in diameter.

The Andover soils are near well-drained Laidig soils and somewhat poorly drained Buchanan soils. All of these soils have similar parent material.

Typical profile of an Andover very stony sandy loam:

- A_0 2 inches or less of black (10YR 2/1), partly decayed organic matter.
- A_{2g} 0 to 6 inches, dark-gray (10YR 4/1) very stony sandy loam mottled with reddish yellow (7.5YR 6/8); weak, medium to thick, platy structure that breaks to weak, fine, subangular blocky; firm when moist; slightly sticky when wet; medium acid; abrupt, wavy boundary; 3 to 5 inches thick.
- B_{21g} 6 to 14 inches, light brownish-gray (10YR 6/2) very stony silty clay loam mottled with reddish yellow (7.5YR 6/8); moderate, medium to coarse, angular blocky structure; firm when moist, sticky when wet; strongly acid; clear, wavy boundary; 7 to 9 inches thick.
- B_{22g} 14 to 30 inches, gray (10YR 6/1) very stony silty clay loam mottled with reddish yellow (7.5YR 6/8); moderate, medium to coarse, subangular blocky structure arranged in prisms; firm when moist, very sticky when wet; thick clay films; very strongly acid; gradual, wavy boundary; 12 to 18 inches thick.
- B_{23g} 30 to 48 inches, brown (10YR 5/3) very stony clay loam; a few, fine, prominent mottles of gray (5Y 6/1); coarse, prismatic structure that breaks to coarse, blocky; very firm; thick clay films; very strongly acid; diffuse, wavy boundary; 12 to 20 inches thick.
- B_{3g} 48 to 72 inches, dark yellowish-brown (10YR 4/4) very stony clay loam; a few, fine, distinct, gray (5Y 6/1) streaks spaced 5 to 8 inches apart; black coatings of iron and manganese are common; coarse, prismatic structure that breaks to moderate, medium, fine blocky; firm when moist; thick clay films; strongly acid.

The texture of the surface layer ranges from sandy loam to silt loam. The subsoil is predominantly silty clay loam, but its texture ranges to sandy clay loam.

The Andover soils are low in natural fertility. Permeability is very slow, and the water table is high. The soils are strongly acid. They do not erode easily.

Andover very stony sandy loam, 0 to 8 percent slopes (AvB).—This is the only Andover soil mapped in the county. The native vegetation under which it formed was poplar, hickory, maple, dogwood, and various kinds of oaks. The soil is too stony and wet for agriculture.

Mapped with this soil are small areas of soils that are very poorly drained.

Andover very stony sandy loam, 0 to 8 percent slopes, is in capability unit VIIs–2; woodland group 11; and group 12 for building sites.

Atkins Series

The Atkins series is made up of deep, poorly drained soils of flood plains. Some areas of these soils consist of clay, silt, and sand that washed from soils of uplands, and they are underlain by acid shale and sandstone. The areas in the southern part of the county, however, formed in local colluvium and alluvium. The colluvium and alluvium was washed from nearby uplands in which the soils are underlain by granite, gneiss, or red Triassic rocks.

The Atkins soils are nearly level or gently sloping and are along creeks and other small streams. Those in drainageways, at the heads of streams, and in draws grade to soils of the uplands that are poorly drained or moderately well drained.

The surface layer of the Atkins soils is very dark gray. In many places their subsoil has mottles that range from pale brown to gray, but in the southern part of the county the mottles in the subsoil are yellowish red to light gray. In many places the surface layer is underlain by layers that contain enough clay to retard the movement of water through the profile. The areas are wet most of the time because of excess surface water and subsurface seepage.

In the southern part of the county, the surface layer of the Atkins soils is thick and silty. The subsoil ranges from reddish gray to brown or dark gray and is mottled.

The Atkins soils on flood plains are near areas of moderately well drained Philo soils. Those in local alluvium are near areas of Chester, Glenville, and Worsham soils in the vicinity of South Mountain. They are also near areas of Croton, Norton, Penn, and Readington soils of the Triassic lowland.

Typical profile of an Atkins silt loam in a cultivated area:

A_p 0 to 8 inches, very dark gray (10YR 3/1) silt loam mottled with yellowish red (5YR 5/6); weak, fine, granular structure; friable when moist, nonsticky when wet; moderately acid; abrupt, wavy boundary; 6 to 9 inches thick.

C_1 8 to 16 inches, gray (10YR 6/1) silt loam mottled with brownish yellow (10YR 6/8); moderate, medium to coarse, blocky structure; firm when moist, very sticky when wet; strongly acid; gradual, wavy boundary; 7 to 9 inches thick.

C_2 16 to 30 inches, gray (10YR 6/1) silty clay loam mottled with brownish yellow (10YR 6/8); strong, coarse, blocky structure; firm when moist, very sticky when wet; strongly acid; clear, wavy boundary; 12 to 15 inches thick.

C_3 30 inches +, gray (10YR 6/1) gritty sandy clay loam mottled with brownish yellow (10YR 6/8); weak, medium, subangular blocky structure; firm when moist, sticky when wet; strongly acid.

These soils have high available moisture capacity and moderate to slow permeability. They are moderate in natural fertility and have a high water table. Atkins soils are suited to frequent cultivation only when they are adequately drained. Consequently, on many farms these soils are used for pasture or as woodland.

Atkins silt loam (Aw).—This nearly level soil has a profile like the one described for the series. The surface layer is very dark gray and contains small chips of gray shale. The surface layer and subsoil are mottled and are saturated with water most of the time. In most places the texture of the surface layer is silt loam, but there are small areas of loam, sandy loam, gravelly loam, or silty clay loam.

This soil is in low areas along creeks and small streams where it receives frequent overflow. It has slow to very slow surface drainage. Crops are seldom damaged by overflow, but the soil is suited to frequent tillage only if it has been adequately drained. A mixture of grasses suitable for poorly drained soils should be used for seeding pastures on this soil. The pastures can be improved by using a system of open drains to lower the water table.

Because of the high water table, trees on this soil have shallow roots and are subject to windthrow. The soil is, therefore, only fair for trees.

This soil is in capability unit IIIw–2; woodland group 11; and group 13 for building sites.

Atkins silt loam, local alluvium, 0 to 3 percent slopes (AxA).—This soil is mostly in drainageways and near seep lines and springs. Its profile is more reddish or brownish than the one described as typical for the series, and the subsoil is generally finer textured. The soil material is nearly free of gravel and fragments of rock.

Mapped with this soil are small areas that are slightly steeper and have a thinner surface layer.

Atkins silt loam, local alluvium, 0 to 3 percent slopes, is too wet for frequent cropping unless it is adequately drained. It is covered by water most of the time. As a result, it is difficult to plow, and crops often drown out. If the soil is used for pasture, grasses and legumes that tolerate wetness are the best. Lime and fertilizer are needed to increase yields. Installing open ditches, where feasible, will help to lower the water table and to improve surface drainage.

Because of the high water table, trees on this soil have shallow roots and are subject to windthrow. Therefore, this soil is only fair for trees.

This soil is in capability unit IIIw–2; woodland group 11; and group 13 for building sites.

Bedford Series

The Bedford series consists of deep, moderately well drained soils of valleys. The soils are nearly level to gently sloping. Their surface layer is dark brown, and their subsoil is yellowish-brown silty clay loam to fine silt loam that is mottled in the lower part. A clayey layer in the lower part of the subsoil retards the flow of water through the profile. As a result, the soils are sometimes waterlogged for short periods. The clayey layer also reduces plant root penetration.

These soils developed in glacial till or in frost-churned material that weathered from cement rock and from pure and impure limestone. In places there are boulders and rounded stones left by glaciers. The soils are in low areas and depressions in valleys underlain by limestone. They are in the central part of the county and in Saucon Valley.

The Bedford soils are near deep, well-drained Washington and Duffield soils and moderately deep Ryder soils. They are also near the somewhat poorly drained Lawrence soils and the poorly drained local alluvium phases of the Melvin soils.

Typical profile of Bedford silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, dark-brown (10YR 3/3) silt loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, wavy boundary; 8 to 11 inches thick.

B_{21} 10 to 17 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, medium to coarse, subangular blocky structure; friable when moist; slightly acid; gradual, wavy boundary; 5 to 9 inches thick.

B_{22} 17 to 25 inches, reddish-yellow (7.5YR 6/6) silty clay loam; weak, medium to thick, platy structure; friable when moist; neutral; clear, wavy boundary; 7 to 9 inches thick.

B_{23m} 25 to 30 inches, strong-brown (7.5YR 5/8) silty clay loam; common, medium, distinct mottles of light yellowish brown (10YR 6/4); moderate, coarse, subangular blocky structure that breaks to thin plates; firm when moist; neutral; clear, wavy boundary; 4 to 10 inches thick.

B_3 30 to 40 inches +, brownish-yellow (10YR 6/6) silty clay loam; common, medium, distinct mottles of very pale brown (10YR 7/4) and strong brown (7.5YR 5/8); moderate, medium to coarse, blocky structure that breaks to thin plates; firm when moist, sticky when wet; 10 to 20 inches thick.

The subsoil ranges from yellowish brown to strong brown or reddish yellow. Depth to mottling ranges from 24 to 36 inches, and depth to the claypan, from 25 to 34 inches. The soils that formed in material weathered from

cement rock generally have a texture that is coarser than that in the profile described, and they lack a fine-textured horizon, or claypan.

The permeability of the subsoil and substratum is moderately slow. The available moisture capacity and natural fertility are high, and the water table is high for short periods. The soils are suited to plants that tolerate wetness and that are not damaged by heaving in winter.

Bedford silt loam, 0 to 3 percent slopes (BdA).—The profile of this soil is the same as the one described as typical for the series.

Mapped with this soil are small areas where the surface layer is slightly thinner and material from the subsoil has been mixed with it.

Bedford silt loam, 0 to 3 percent slopes, is well suited to corn, mixed hay crops, pasture, and trees. The claypan in the lower part of the subsoil, however, retards water from moving downward and reduces root penetration. Excess water in the profile late in winter and early in spring is likely to drown out small grains and deep-rooted crops, or those crops may be killed by heaving.

Using tile in large fields to drain the seep spots makes these soils easier to cultivate and improves yields. Diversion terraces help to protect the areas from runoff. A suitable rotation is one in which a row crop is grown no oftener than once in 3 years.

This soil is in capability unit IIw–1; woodland group 9; irrigation group 4; and group 10 for building sites.

Bedford silt loam, 3 to 8 percent slopes (BdB).—The profile of this soil is similar to the one described for the series, but the surface layer is thinner and material from the subsoil has been mixed with it. Depth to mottling is also slightly greater.

This soil is suited to corn, mixed hay crops, pasture, and trees. It is subject to erosion, however, if used for row crops. Grasses and legumes that tolerate wetness should be grown. Excess water in the profile in winter and spring is likely to drown out small grains or to cause them to be killed by heaving.

Using tile to drain seep spots will help improve drainage. Graded stripcropping and diversion terraces will remove excess surface water and will also help to control erosion. Using a rotation that includes 2 years of cultivated crops and 1 year of a hay crop helps to reduce erosion, conserve moisture, and maintain organic matter in the soil.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Bedford silt loam, 3 to 8 percent slopes, moderately eroded (BdB2).—The profile of this soil is similar to the one described as typical for the series, but material from the former subsoil has been mixed with the surface soil by plowing. The profile also contains a few fragments of rock, and depth to mottling is slightly greater.

This soil is suited to corn, mixed hay crops, pasture, and trees. Grasses and legumes that tolerate wetness should be used for mixed hay crops and pasture. The claypan in the lower part of the subsoil impedes the downward movement of water. As a result, excess water is likely to drown out small grains in spring.

Using tile to drain seep spots will improve the drainage of this soil. On long slopes graded stripcropping can be used to prevent serious erosion. Diversion terraces will help protect low-lying fields from runoff and will remove excess surface water.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Bedford and Lawrence silt loams, 0 to 3 percent slopes (BeA).—In this mapping unit the soils occur together on flats and in drainageways and other low areas. They are too intermingled to be mapped separately. The profile of the Bedford soil is similar to the one described as typical for the series. A typical profile of a Lawrence silt loam is described under the Lawrence series. Lawrence soils are somewhat poorly drained; hence, they are a little wetter than the Bedford soils.

The surface layer of these soils is generally thick because of material that has accumulated on them. In small areas, however, gullies have been caused by the flow of large amounts of surface water. The subsoil ranges from silt loam to silty clay loam in texture. Depth to the claypan in the subsoil varies.

These soils are moderately well drained to somewhat poorly drained. Permeability is moderately slow in the subsoil and substratum, and there is mottling from just below the plow layer to a depth of 34 inches.

In these soils the claypan slows the downward movement of water. As a result, the soils are likely to be wet until late in spring. If they are not drained, they are suited only to pasture and trees and to crops that tolerate wetness. Alfalfa, small grains, and other crops that are sensitive to wetness drown out.

Open ditches or tile drains can be used to improve the drainage of these soils. A suitable 4-year rotation includes at least 2 years of a hay crop. Applying fertilizer will increase yields.

This mapping unit is in capability unit IIIw–1; woodland group 9; irrigation group 4; and group 12 for building sites.

Bedford and Lawrence silt loams, 3 to 8 percent slopes (BeB).—The soils in this mapping unit have a surface layer that is thinner than that of Bedford and Lawrence silt loams, 0 to 3 percent slopes. Also, there are fewer areas where soil material from other areas has accumulated, and the areas contain a larger proportion of Bedford soils. In small areas varying amounts of material from the subsoil have been mixed with the surface layer.

These soils are suited to crops that tolerate wetness. Alfalfa, small grains, and other crops that cannot tolerate wetness will drown out or will be killed as the result of heaving in winter.

If feasible, tile drains and open ditches can be used to improve the areas for crops. If they are used, yields will generally increase. Fertilizer is needed, however, for highest yields.

These soils are in capability unit IIIw–1; woodland group 9; irrigation group 4; and group 12 for building sites.

Brandywine Series

The Brandywine series consists of well-drained, gravelly soils that are shallow to moderately deep over bedrock. The surface layer of these soils is dark-brown loam, and the subsoil is yellowish-brown gravelly sandy loam.

These soils formed in material weathered from granitic gneiss, granite, and quartz-monzonite. They are on hillsides and on the steep slopes of ridges in the southern part of the county.

The Brandywine soils are near areas of deep, well-drained Chester soils and moderately deep to deep, well-drained Fleetwood soils. They are also near areas of moderately well drained Glenville and poorly drained Worsham soils.

Typical profile of Brandywine loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area :

A_p 0 to 7 inches, very dark brown (10YR 2/2) loam; 30 percent coarse fragments; weak, fine, granular structure; very friable when moist, nonsticky when wet; medium acid; abrupt, wavy boundary; 6 to 8 inches thick.

B_2 7 to 19 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; 60 percent coarse fragments; weak, fine, granular structure; very friable when moist, nonsticky when wet; strongly acid; gradual, wavy boundary; 9 to 12 inches thick.

C 19 to 29 inches, yellowish-brown (10YR 5/4) gravelly sandy loam; 80 percent coarse fragments; structureless; friable when moist; strongly acid; irregular boundary; 6 to 10 inches thick.

D_r 29 inches +, granite gneiss that has weathered in place.

The subsoil is yellowish-brown to yellowish-red gravelly loam to gravelly sandy clay loam. The solum is 10 to 24 inches thick.

These soils have moderately rapid to rapid permeability. They are low in available moisture capacity and in natural fertility.

The soils are fair for general farm crops, orchards, and woodland. In most places practices are needed to control erosion and to conserve moisture.

Brandywine loam, 3 to 8 percent slopes, moderately eroded (BfB2).—The profile of this soil is the same as the one described as typical for the series. From one-fourth to three-fourths of the original surface layer remains, but the rest has been lost through erosion. The present surface layer is loam that contains grit. The subsoil contains coarse fragments of rock that are mixed with fine sand and gravel.

Mapped with this soil are small areas in which the surface layer is somewhat thinner and contains larger amounts of gravel than the one in the profile described.

Brandywine loam, 3 to 8 percent slopes, moderately eroded, is on the tops of ridges and hills. It is poor to fair for the farm crops generally grown in the county, and it is fair for orchards. If this soil is used for row crops, it is subject to serious erosion.

Contour stripcropping can be used on this soil to help control erosion and to conserve moisture. Diversion terraces will help to carry away excess surface water. A suitable 3-year rotation includes no more than 1 year each of a small grain and a row crop.

This soil is in capability unit IIe–3; woodland group 12; irrigation group 7; and group 7 for building sites.

Brandywine loam, 8 to 15 percent slopes, moderately eroded (BfC2).—The surface layer of this soil contains more gravel and larger amounts of material from the subsoil than that in the profile described as typical for the series. In places near the bottom of slopes where soil material has accumulated, are small areas of a deeper soil.

Brandywine loam, 8 to 15 percent slopes, moderately eroded, is on rolling ridges. It is fair for the crops that are commonly grown in the county. If tilled crops are grown, however, the soil is subject to erosion.

Contour stripcropping and growing grasses and legumes in long rotations will help to control erosion. Diversion terraces will help remove the excess surface water. Lime and fertilizer are needed for best yields. A suitable rotation for this soil includes at least 2 years of a hay crop and no more than 1 year of a row crop.

This soil is in capability unit IIIe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Brandywine loam, 8 to 15 percent slopes, severely eroded (BfC3).—The surface layer of this soil is thinner than the one in the profile described for the series, and it contains larger amounts of gravel and fragments of rock. Also, larger amounts of material from the subsoil are mixed into the plow layer. In some places there are a few rills and gullies.

This soil is on the sides of rolling hills. It can be used for tilled crops occasionally, but it is better suited to hay crops and orchards. The soil is subject to severe erosion if it is tilled. Therefore, it should be tilled only when it is necessary to reseed a hay crop. Lime and fertilizer are needed for best yields. Using diversions and growing the crops in contour strips will help to control erosion and to conserve moisture.

This soil is in capability unit IVe–3; woodland group 14; irrigation group 7; and group 8 for building sites.

Brandywine loam, 15 to 25 percent slopes, moderately eroded (BfD2).—The surface layer of this soil is slightly thinner than the one in the profile described for the series, and it contains a large amount of gravel.

Mapped with this soil are small areas of a soil formed in material accumulated as the result of downhill creep and erosion.

Brandywine loam, 15 to 25 percent slopes, moderately eroded, is on the sides of ridges. It is suited to hay crops and orchards, but it is subject to severe erosion when it is tilled. Therefore, crops that require tillage should be grown only when hay crops need to be reseeded. Using stripcropping along with diversions on long slopes will help to control erosion and to conserve moisture.

This soil is in capability unit IVe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Brandywine loam, 15 to 25 percent slopes, severely eroded (BfD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner. Also, much of the finer material in the surface layer has been removed through erosion and the present surface layer is coarse textured. In some places, the former subsoil is exposed and there are many gullies.

This soil is on the sides of rolling hills and ridges. It is probably best suited to pastures and trees. If it is pastured, the pastures should be rotated. Overgrazing will cause serious erosion. Lime and fertilizer are required if pasture plants are to make good growth.

This soil is in capability unit VIe–2; woodland group 14; irrigation group 7; and group 8 for building sites.

Brandywine loam, 25 to 35 percent slopes, severely eroded (BfE3).—The profile of this soil is like the one described as typical for the series, but it has a much thinner surface layer. The subsoil is exposed in many places, and gravel and fragments of rock are concentrated on the surface. There are small areas at the bottom of slopes

where soil material has accumulated as the result of erosion.

This soil is on the very steep slopes of ridges. It is probably best suited to trees or to use for wildlife areas. The soil is too steep and shallow to be used for agriculture.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Buchanan Series

The Buchanan series consists of deep, silty soils that are moderately well drained. The surface layer of these soils is very dark brown, and their subsoil is mottled at a depth between 24 and 36 inches. The mottling developed because of moisture held back by a slowly permeable layer of silty clay that impedes drainage. The soils are on the lower slopes of Blue Mountain. They formed in colluvial material from sandstone, shale, and conglomerate that slipped down from the higher slopes of the mountain. The slopes are gentle to strong.

In places these soils are in small areas that have been cleared of trees and stones. In those areas there are fewer pebbles and stones on the surface than are on the surface of other areas of Buchanan soils, but the profile is similar to that in areas where the stones have not been removed.

The Buchanan soils are near areas of Extremely stony land. They are also near deep, well-drained Laidig soils and deep, poorly drained Andover soils.

Typical profile of Buchanan gravelly loam, 3 to 8 percent slopes, in a cultivated area:

A_p 0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly loam; 30 percent coarse fragments; moderate, medium, granular structure; very friable when moist, nonsticky when wet; very strongly acid; abrupt, smooth boundary; 7 to 9 inches thick.

B_{21} 8 to 18 inches, yellowish-brown (10YR 5/4) gravelly silty clay loam; 20 percent coarse fragments; moderate, medium, subangular blocky structure; friable when moist, sticky when wet; strongly acid; gradual, wavy boundary; 9 to 10 inches thick.

B_{22} 18 to 29 inches, yellowish-brown (10YR 5/6) silty clay loam; 10 percent coarse fragments; moderate to strong, coarse, angular blocky structure; firm when moist, very sticky when wet; strongly acid; gradual, wavy boundary; 10 to 12 inches thick.

B_{23} 29 to 36 inches, brownish-yellow (10YR 6/6) silty clay loam mottled with very pale brown (10YR 7/4); moderate to strong, coarse, angular blocky structure; firm when moist, sticky when wet; strongly acid; gradual, wavy boundary; 6 to 9 inches thick.

B_3 36 to 48 inches +, yellowish-brown (10YR 5/6) silt loam; a few, fine, faint mottles that are strong brown (7.5YR 5/6) or brown (7.5YR 5/4); weak, thin, platy structure to moderate, medium, blocky; firm when moist; very strongly acid; 12 or more inches thick.

In most places the Buchanan soils are stony. The subsoil ranges from fine sandy loam to silty clay loam.

These soils have moderate available moisture capacity. The permeability of the substratum is moderately slow. The soils are low in natural fertility.

Buchanan gravelly loam, 3 to 8 percent slopes (BgB).—This soil has the profile described as typical for the series. The surface layer is very dark brown, and the subsoil is yellowish brown. There is gravel throughout the surface layer and the subsoil. The subsoil has a claypan or tight layer that retards drainage through the soil and causes mottling at a depth between 26 and 34 inches.

Included with this soil is a poorly drained soil in areas too small to be mapped separately.

Most of Buchanan gravelly loam, 3 to 8 percent slopes, is wooded, and only a few acres are used for crops. The soil is well suited to most field crops generally grown in the county, but alfalfa and small grains are likely to freeze out in winter. The areas are small, and boulders and rocks have been moved from the fields to the borders of fields and to hedgerows.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded (BgB2).—The profile of this soil is like the one described for the series, but it has a somewhat thinner surface layer and more gravel is on the surface.

Most of this soil has been cleared, and many of the large stones have been pushed to the edges of the fields. The areas are mostly used for crops. In a few places some areas of a poorly drained soil are included with this soil. These included areas are generally in pasture or are left idle.

Buchanan gravelly loam, 3 to 8 percent slopes, moderately eroded, is fairly well suited to most crops, but alfalfa and small grains are likely to be damaged by heaving. Tile drains will remove excess water from the seep spots, but it is difficult to install the tile because of the boulders and the claypan in the subsoil. Using graded strips will help to prevent further erosion.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Buchanan very stony loam, 0 to 8 percent slopes (BhB).—The profile of this soil is like the one described as typical for the series, but there is a thin cover of dark-colored organic material on the surface layer. Also, rocks make up between 10 and 20 percent of the surface layer and subsoil. The lower part of the subsoil is mottled. This nearly level to gently sloping soil is on the lower slopes of Blue Mountain.

All of this soil is in trees. The boulders and stones make it very costly to clear the areas. Consequently, this soil is better suited to trees than to other uses. The trees grow well, but they are subject to windthrow.

This soil is in capability unit VIs–1; woodland group 9; and group 10 for building sites.

Buchanan very stony loam, 8 to 25 percent slopes (BhD).—The profile of this soil is like the one described as typical for the series, but the surface layer contains more boulders and the subsoil has a much coarser texture. This soil is moderately sloping to strongly sloping and is in areas adjacent to intermittent streams and seeps that drain the upper slopes of Blue Mountain.

Because of the stones, this soil is better suited to trees than to other uses. Many of the trees have been cut, and the stands that are now on the areas are of various ages.

This soil is in capability unit VIs–1; woodland group 10; and group 11 for building sites.

Chester Series

The Chester series is made up of deep soils that are well drained and silty. The surface layer of these soils is grayish brown to strong brown. Their subsoil is strong-brown or yellowish-red gravelly or stony silty clay loam that contains many small pieces of bright, shiny mica. Just

Figure 6.—**A typical landscape of Chester soils has corn, wheat straw, corn, and oats in strips on the gentle slopes and forests on the hilly areas.**

below the subsoil is a layer of silt loam, about 2 feet thick, that contains noticeable amounts of medium and coarse, angular sand. Varying amounts of angular fragments of stone are scattered throughout the profile. The native vegetation on these soils was chiefly mixed oak, red maple, hickory, yellow-poplar, and walnut, but it included some conifers.

These soils developed in material weathered from the underlying gneiss and schist or from clayey glacial till. The till was derived mostly from gneiss and granite, but it included small amounts of quartzite.

The soils are on gently rounded ridges and hillsides. They are mostly in a belt about 5 miles wide that extends mainly from the southwest to the northeast across the southern part of the county. Figure 6 shows a typical landscape of Chester soils.

In many places these soils are near the shallow, well-drained Brandywine soils. They are also near deep, moderately well drained to somewhat poorly drained Glenville soils, poorly drained Worsham soils, and very poorly drained Woodglen soils. All of these soils formed in similar parent material. The Chester soils have more distinct horizons than the Brandywine soils, and their subsoil is finer textured and has more definite structure. They also contain fewer coarse, angular fragments and cobbles than the Brandywine soils.

Typical profile of Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded, in a cultivated area:

A_p 0 to 10 inches, dark-brown (10YR 4/3) gravelly silt loam; 10 percent angular gravel; moderate, fine, granular structure; friable when moist; slightly acid; abrupt, wavy lower boundary; 8 to 12 inches thick.

A_3 10 to 14 inches, strong-brown (7.5YR 5/6) gritty silt loam; weak, fine, blocky structure; friable when moist, slightly sticky when wet; thin, discontinuous clay films, slightly acid; clear, broken boundary; 0 to 4 inches thick.

B_{21} 14 to 20 inches, strong-brown (7.5YR 5/6), gritty, fine silt loam; moderate, medium to fine, blocky structure; friable when moist, slightly sticky when wet; well-developed clay films; slightly acid; gradual, wavy boundary; 5 to 8 inches thick.

B_{22} 20 to 26 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, medium, blocky structure; firm when moist, slightly sticky and plastic when wet; prominent clay films and coatings of iron and manganese on peds; slightly acid; gradual, wavy boundary; 5 to 7 inches thick.

B_{23} 26 to 36 inches, strong-brown (7.5YR 4/6) and dark-brown (7.5YR 4/4), gritty, fine silt loam; weak, medium, blocky structure; friable when moist, slightly sticky when wet; slightly acid; clay films on the surfaces of some peds and pores; clear, wavy boundary; 8 to 11 inches thick.

B_3 36 to 41 inches, strong-brown (7.5YR 4/6) gritty silt loam; coarse, blocky structure; friable when moist; thin clay films; slightly acid; clear, wavy boundary; 4 to 6 inches thick.

C_1 41 to 50 inches, yellowish-brown (10YR 5/8) coarse sandy loam, structureless; friable when moist, slightly sticky when wet; very porous; slightly acid.

The texture of the surface layer ranges from silt loam to gravelly silty clay loam. The subsoil ranges from yellowish brown to reddish brown. The solum is 24 to 60 inches thick.

These soils have high available moisture capacity. Permeability is moderate. The soils are moderately fertile, but in some places there are wet spots that affect management.

Chester gravelly silt loam, 0 to 3 percent slopes, moderately eroded (CgA2).—The profile of this soil is similar to the one described as typical for the series. A small amount of gravel is scattered through the profile, and the plow layer contains some material from the subsoil. In a few places the soil is wooded, and in those areas it has not been eroded. Also, in some places there are slight depressions where soil material from higher areas has accumulated. The soil is on broad ridgetops. It has slow to moderate runoff, and it is subject to erosion.

This soil is well suited to general farm crops grown in a rotation of medium intensity. Farming on the contour where slopes are more than 2 percent will help to control erosion.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 1; and group 1 for building sites.

Chester gravelly silt loam, 3 to 8 percent slopes (CgB).—The surface layer of this soil is thicker than that in the profile described as typical for the series, and the parent material is at a slightly greater depth. Also, smaller amounts of gravel are scattered throughout the profile. The surface layer is generally 9 to 12 inches thick. This soil is in undulating areas or on broad, gently sloping ridgetops and benches. In places it is at the foot of slopes where soil material has accumulated. Many of the areas are wooded, and in these areas runoff is slow to medium.

This soil is fairly well suited to general farm crops grown in a rotation that includes a hay crop at least 1 year out of every 3. Diversion terraces and contour stripcropping are needed to protect the soil from serious erosion.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 1; and group 1 for building sites.

Chester gravelly silt loam, 3 to 8 percent slopes, moderately eroded (CgB2).—This soil has a profile similar to the one described for the series. In some places material from the subsoil has been mixed into the plow layer. The soil is on broad, gently sloping ridgetops where runoff is slow to medium. It is subject to erosion.

This soil is fairly well suited to general farm crops grown in a rotation that includes a hay crop at least 1

year out of every 3. Diversion terraces and contour stripcropping can be used to prevent more serious erosion.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 1; and group 1 for building sites.

Chester gravelly silt loam, 3 to 8 percent slopes, severely eroded (CgB3).—The profile of this soil is similar to the one described as typical for the series, but it lacks the thick surface layer. Also, it has more gravel on the surface, and a larger amount of material from the subsoil is mixed into the plow layer.

This soil is fair for general farm crops. It needs a rotation in which hay crops are grown at least 2 years in every 4.

This soil is in capability unit IIIe–2; woodland group 3; irrigation group 1; and group 1 for building sites.

Chester gravelly silt loam, 8 to 15 percent slopes (CgC).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thicker and the parent material is at a slightly greater depth.

Nearly all of this soil is in trees, but small areas are in pasture or in hay crops. The soil is on hillsides near the tops of broad ridges and on the lower slopes in valleys. Runoff is medium to rapid, and the soil is subject to erosion.

This soil is fair for general farm crops. A rotation is needed in which hay crops are grown at least 2 years out of every 4. If the soil is used for row crops, stripcropping and diversion terraces are needed to control erosion.

This soil is in capability unit IIIe–2; woodland group 4; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 8 to 15 percent slopes, moderately eroded (CgC2).—The profile of this soil is the one described as typical for the series. The soil has retained most of its original surface layer, but in some places material from the subsoil has been mixed into the plow layer. Runoff is medium to rapid on this soil, and sheet and rill erosion are common.

Most areas of this soil are in crops or pasture. The soil is fair for general farm crops if a suitable rotation is used. Areas that are in row crops require contour stripcropping. Diversion terraces are needed on long slopes to control erosion and to conserve moisture.

This soil is in capability unit IIIe–2; woodland group 4; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 8 to 15 percent slopes, severely eroded (CgC3).—The profile of this soil is similar to the one described for the series, but the parent material is nearer the surface. Also, the surface layer contains more gravel and varying amounts of material from the subsoil have been mixed into the plow layer. This soil is on the sides of broad ridges. Surface runoff is medium to rapid, and the soil erodes easily.

This soil is better suited to hay than to tilled crops, and a small grain can be grown occasionally. Cultivating should be done only when it is necessary to seed the small grain. Reseeding in strips also helps to reduce sheet and gully erosion. Using diversion terraces and contour stripcropping will help to control runoff.

This soil is in capability unit IVe–2; woodland group 6; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 15 to 25 percent slopes (CgD).—Although this soil has strong slopes, nearly all of its original surface layer remains. The soil is on the sides of valleys. Runoff is rapid to very rapid, and the soil is likely to erode if it is cultivated. Most of the acreage is wooded, but a small acreage is in pasture and hay.

If this soil is cleared for farming, it is best used to grow hay crops and an occasional crop of small grain. Cultivating only when seeding the small grain, and reseeding pasture in contour strips, will help to prevent erosion. Diversion terraces that have adequate outlets are needed on long slopes.

This soil is in capability unit IVe–2; woodland group 4; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 15 to 25 percent slopes, moderately eroded (CgD2).—The profile of this soil is similar to the one described as typical for the series, but bedrock is at a somewhat greater depth. This soil is on the strongly sloping sides of ridges. Runoff is rapid to very rapid, and the soil is subject to erosion.

This soil is better suited to permanent hay than to tilled crops. A small grain can be planted periodically in contour strips to help reseed the areas. Diversion terraces are needed on the long slopes to remove runoff.

This soil is in capability unit IVe–2; woodland group 4; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 15 to 25 percent slopes, severely eroded (CgD3).—The profile of this soil is similar to the one described as typical for the series, but the parent material is nearer the surface. The surface layer is also thinner and contains some gravel. This soil is on the strongly sloping sides of valleys. Runoff is rapid to very rapid, and the soil erodes easily. In some places the finer material has been washed away and large amounts of mixed gravel have been left on the surface. Gullies are common.

This soil is better suited to pasture than to tilled crops. Using contour strips to reseed pastures, and installing diversion terraces on long slopes, if feasible, will reduce runoff and will help prevent further erosion.

This soil is in capability unit VIe–1; woodland group 6; irrigation group 1; and group 2 for building sites.

Chester gravelly silt loam, 25 to 35 percent slopes (CgE).—Although this soil has strong slopes, its profile is similar to the one described as typical for the series. Most of the acreage is wooded, but some small areas are in pasture. The soil is on the sides of narrow valleys. It erodes easily.

This soil is better suited to pasture than to tilled crops. In some places diversion terraces can be used to reduce runoff and to conserve moisture.

This soil is in capability unit VIe–1; woodland group 7; irrigation group 1; and group 9 for building sites.

Chester gravelly silt loam, 25 to 35 percent slopes, moderately eroded (CgE2).—The profile of this soil is similar to the one described as typical for the series, but bedrock is nearer the surface. This soil is on the sides of valleys. Runoff is very rapid, and the soil erodes easily.

This soil is suited to pasture and trees, and it is used mainly for pasture. The pastures should be reseeded in strips to help prevent further erosion. In some places diversion terraces can be used to reduce runoff and to conserve moisture.

This soil is in capability unit VIe–1; woodland group 7; irrigation group 1; and group 9 for building sites.

Chester gravelly silt loam, 25 to 35 percent slopes, severely eroded (CgE3).—The profile of this soil is similar to the one described as typical for the series, but bedrock is nearer the surface. The soil is on the sides of steep, narrow valleys. Runoff is very rapid. On the surface there is much gravelly material and material deposited by downhill creep.

Much of this soil is idle. Its best use is probably as woodland or as areas for wildlife. The soil is suitable for the planting of Christmas trees.

This soil is in capability unit VIIe–1; woodland group 8; irrigation group 1; and group 9 for building sites.

Chester very stony silt loam, 0 to 8 percent slopes (ChB).—The profile of this soil is similar to the profile of the Chester gravelly silt loam described as typical for the series, but boulders of granite and gneiss are scattered over the surface. The boulders are also scattered throughout the profile. This soil has ½ to 2 inches of black, organic material over a lighter colored surface layer. All of this soil is wooded. Runoff is slow to medium.

This soil can be used to a limited extent for pasture, or it can be used as woodland or for habitats for wildlife. The large boulders and excessive amount of stones make it impractical to clear the areas for row crops. In most places the larger trees have been cut for lumber and the smaller ones have been left for future use.

This soil is in capability unit VIs–1; woodland group 1; and group 5 for building sites.

Chester very stony silt loam, 8 to 25 percent slopes (ChD).—The profile of this soil is similar to the one described for the series, but bedrock is somewhat nearer the surface and the soil material in many places is more sandy. Stones and boulders, similar to those on Chester very stony silt loam, 0 to 8 percent slopes, are on the surface and scattered throughout the profile. The soil is on the sides of South Mountain and other ridges.

All of this soil is in trees. Clearing the areas would be costly, and, if cleared, the soil could be used to only a limited extent for pasture.

This soil is in capability unit VIs–1; woodland group 4; and group 6 for building sites.

Chester very stony silt loam, 25 to 50 percent slopes (ChF).—The profile of this soil is similar to the profile described as typical for the series, but bedrock is nearer the surface. The boulders and outcrops of rock on or near the surface are larger than those on Chester very stony silt loam, 0 to 8 percent slopes, and there are more pieces of rock in the profile. The soil is on the steep and very steep sides of South Mountain and on the highest ridges.

This soil is better used as woodland or for wildlife areas than for other purposes. It is impractical to clear the areas for pasture or to cultivate them, because the soils are stony and steep and are shallow over bedrock. All of the soil is wooded, but most of the large trees have been cut for lumber.

This soil is in capability unit VIIs–1; woodland group 7; and group 9 for building sites.

Comly Series

The Comly series consists of deep, moderately well drained to somewhat poorly drained soils of uplands. The surface layer of these soils is very dark brown silt loam. The subsoil is yellowish brown to very pale brown and has reddish and grayish mottles. These soils formed on glacial till or colluvium from acid, gray shale and sandstone of the Martinsburg formation. They are on the lower slopes of areas on the uplands. The Comly soils are nearly level to moderately sloping, but they are predominantly gently sloping. The subsoil contains a well-expressed fragipan (dense layer) that is fairly high in clay.

These soils are mostly near the deep, well-drained Trexler soils and the moderately deep, well-drained, moderately shallow Trexler soils. They are also near the shallow, well-drained Montevallo soils and the poorly drained Shelmadine soils.

Typical profile of Comly silt loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area:

- A_p 0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable when moist; medium acid; abrupt, smooth boundary; 7 to 11 inches thick.
- B_1 10 to 13 inches, light yellowish-brown (10YR 6/4) shaly silt loam; weak, fine, granular structure; friable when moist; strongly acid; clear, wavy boundary; 2 to 6 inches thick.
- B_{21} 13 to 18 inches, brownish-yellow (10YR 6/6) shaly silt loam; moderate, fine, subangular blocky structure; friable when moist; strongly acid; clear, wavy boundary; 3 to 8 inches thick.
- B_{22} 18 to 26 inches, yellowish-brown (10YR 5/6) shaly silty clay loam; moderate, medium, angular blocky structure; firm when moist; very strongly acid; gradual, wavy boundary; 7 to 10 inches thick.
- B_{23} 26 to 34 inches, yellowish-brown (10YR 5/4) shaly silt loam; a few, medium, distinct mottles of very pale brown (10YR 7/3); moderate, coarse, angular blocky structure; firm when moist; coatings of iron and manganese on the faces of peds; very strongly acid; gradual, wavy boundary; 8 to 12 inches thick.
- B_3 34 to 44 inches, yellowish-brown (10YR 5/4) silty clay loam; many, medium, distinct mottles of strong brown (7.5YR 5/6) and pale brown (10YR 6/3); moderate, coarse, angular blocky structure; firm when moist; coatings of iron and manganese are common on the faces of peds; very acid; gradual, wavy boundary; 9 to 12 inches thick.
- C_1 44 inches +, strong-brown (7.5YR 5/6) shaly silt loam; weak, fine, subangular blocky structure; friable when moist; very strongly acid.

The texture of the surface layer ranges from shaly silt loam to silt loam, but it is predominantly silt loam. The texture of the subsoil ranges from shaly silt loam to silty clay loam. Depth to mottling ranges from 24 to 34 inches in areas that are moderately well drained, and from 18 to 24 inches in areas that are somewhat poorly drained.

The movement of water through the profile is moderately slow. The moisture-holding capacity is high.

Comly silt loam, 0 to 3 percent slopes (CmA).—The profile of this soil is like the one described as typical for the series, but it is less eroded. In many places the soil has received deposits of silty material from higher lying soils. Chips of shale, as much as one-half inch in diameter, are in the surface layer and subsoil.

Mapped with this soil are small areas of soils that are poorly drained. Many areas lie below more sloping soils, and excess water is likely to stand on them after a heavy rain.

Small grains and alfalfa grown on Comly silt loam, 0 to 3 percent slopes, are likely to be winterkilled, but other crops and mixtures commonly used for pasture grow fairly well. Supplemental drainage is needed for good yields. The tile drains that are used in some places to

provide drainage work well. Diversion terraces can be used to prevent water from higher areas from damaging this soil.

This soil is in capability unit IIw–1; woodland group 9; irrigation group 4; and group 10 for building sites.

Comly silt loam, 3 to 8 percent slopes (CmB).—The surface layer of this soil is thicker than the one in the profile described as typical for the series. This soil is subject to erosion if it is used for tilled crops, and winter grain or alfalfa grown on it are commonly winterkilled.

If this soil is used for tilled crops, practices are needed that help to control erosion. Diversion terraces can also be used to help control erosion and to improve drainage. Graded stripcropping can be used on the long slopes. Growing legumes and grasses in the rotation helps to return organic matter to the soil and to improve the structure.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Comly silt loam, 3 to 8 percent slopes, moderately eroded (CmB2).—The profile of this soil is the same as the one described as typical for the series. Although the soil is moderately eroded, it has retained from one-fourth to three-fourths of its original surface layer.

Mapped with this soil are small areas of a soil that is slightly reddish and contains some cobbles and pebbles.

Comly silt loam, 3 to 8 percent slopes, moderately eroded, is fairly well suited to corn and small grains. Alsike clover, ladino clover, and red clover grow fairly well on it, but alfalfa is likely to be winterkilled.

If this soil is used for cultivated crops, graded strips can be used on the longer slopes; diversion terraces can also be used to reduce erosion. In some places tile can be used to improve drainage and to help remove subsurface water.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Comly silt loam, 8 to 15 percent slopes, moderately eroded (CmC2).—The surface layer of this soil is thinner than that in the profile described as typical for the series. It also contains more shale, and the fragments of shale are larger. In some places material from the subsoil has been mixed into the plow layer.

This soil is fairly well suited to most of the crops generally grown in the county, but small grains and alfalfa grown on it are often winterkilled. Corn grows fairly well in years of normal rainfall.

If this soil is used for crops, erosion is likely to be severe. Diversion terraces and graded stripcropping can be used on the long slopes to help control erosion. In some places tile can be used to drain the areas. If the soil is drained, yields will improve.

This soil is in capability unit IIIe–4; woodland group 10; irrigation group 4; and group 11 for building sites.

Croton Series

The Croton series consists of deep soils that are poorly drained. The surface layer of these soils in areas that are tilled is dark grayish-brown silt loam. The subsoil is yellowish-brown silty clay loam that grades to clay loam. Below a depth of 15 inches, the subsoil has a slowly permeable claypan in which there are variegated mottles of yellow, red, pink, and gray. The parent material of these soils is material weathered from red shale and sandstone of Triassic age. The soils are in shallow depressions and on low, gentle slopes in the southern part of the county.

In most places these soils are near the shallow and moderately deep, well-drained Penn soils. They are also near the deep, well drained Norton soils and the deep, moderately well drained Readington soils.

Typical profile of Croton silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable when moist, nonsticky when wet; slightly acid; abrupt, smooth boundary; 6 to 9 inches thick.

B_{21g} 9 to 15 inches, grayish-brown (10YR 5/2) silty clay loam; a few, fine, faint mottles of strong brown (7.5YR 5/8); moderate, medium to coarse, blocky structure; friable when moist, slightly sticky when wet; slightly acid; clear, smooth boundary; 6 to 9 inches thick.

B_{22g} 15 to 22 inches, strong-brown (7.5YR 5/8) silty clay loam; common, fine, distinct mottles of reddish yellow (7.5YR 7/6) and yellowish red (5YR 5/8); strong, coarse, subangular blocky structure in coarse prisms; firm when moist, very sticky when wet; strongly acid; clear, smooth boundary; 5 to 10 inches thick.

B_{23mg} 22 to 34 inches, yellowish-red (5YR 5/6) clay loam; many, medium, distinct mottles of pink and pinkish gray (7.5YR 7/5 and 7/2) and yellowish red (5YR 4/8); strong, coarse, blocky structure; very firm when moist, sticky when wet; some coatings of iron and manganese on the surfaces of peds; strongly acid; gradual, wavy boundary; 9 to 11 inches thick.

B_{3mg} 34 to 38 inches, weak-red (10R 4/3) silty clay and fractured shale; common, medium, prominent mottles of pinkish gray (7.5YR 7/2); weak, fine, subangular blocky structure; the number of shale fragments increases with increasing depth; firm when moist; strongly acid; clear, wavy boundary; 3 to 6 inches thick.

D_r 38 inches, dusky-red (2.5YR 3/2), soft, shattered shale; common, medium, distinct mottles or pinkish-gray (5YR 6/2) coatings of silt; shale is firmer with increasing depth.

In most places the subsoil is mottled at a depth between 8 and 12 inches, but in some places mottling is within 6 inches of the surface.

Although most areas of Croton soils are free of stones, rounded stones 3 to 18 inches in diameter are common in wooded areas, idle areas, and pastures. In a few places there are boulders that are 2 to 3 feet in diameter.

The Croton soils are slowly or very slowly permeable and are slow to warm in spring. They have moderate available moisture capacity.

Croton silt loam, 0 to 3 percent slopes (CrA).—The profile of this soil is the one described as typical for the series. The soil is nearly level and is in depressions, in drainageways, and on the lower parts of slopes. Its subsoil is slowly permeable, and the substratum is very slowly permeable. As a result, the soil remains wet until late in spring and warms slowly.

Mapped with this soil are areas of moderately well drained to somewhat poorly drained Readington silt loam, 0 to 3 percent slopes. These included areas are too small to be mapped separately.

Croton silt loam, 0 to 3 percent slopes, is better suited to pasture, hay, and trees than to tilled crops. It requires drainage if it is used for tilled crops or if the best yields of hay and pasture are to be obtained. Grasses and clovers

that tolerate wetness are the best plants to grow. Much of this soil is used for bluegrass, which makes fairly good yields.

Open ditches can be used to provide drainage, and they work fairly well. The subsoil is generally too tight for tile drains to be satisfactory.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for building sites.

Croton silt loam, 3 to 8 percent slopes (CrB).—The profile of this soil is similar to the one described as typical for the series, but the mottling is somewhat less intense. The soil also has gentle slopes and slightly better surface drainage. The permeability of the subsoil is slow, and that of the underlying material is very slow.

This soil is probably best used for pasture or for hay, but tilled crops can be grown if adequate drainage is provided.

Bedding, graded stripcropping, and diversion terraces can be used to provide drainage, and tile can be used in some places. Lime and fertilizer are needed for best yields. The pastures should not be grazed in spring until the soil is dry enough that it will not be damaged by trampling.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for buiding sites.

Croton very stony loam, 0 to 8 percent slopes (CsB).—This soil contains many stones and boulders that, in places, are as large as 3 feet in diameter or larger. Nearly all of this soil is wooded. It has a thin layer of organic material that overlies a dark-brown A_1 horizon of silt loam. The A_1 horizon is about 4 inches thick and has medium, granular structure. The A_2 horizon is 11 inches thick and consists of light grayish-brown silt loam that has fine to medium, platy structure. Below this horizon, the profile is similar to the profile described as typical for the series, but it contains a larger number of stones.

The many stones and poor drainage make this soil unsuited to general farm crops, and the areas are probably best kept in trees. If the soil is cleared of stones, it can be managed in about the same way as Croton silt loam, 3 to 8 percent slopes.

This soil is in capability unit VIIs–2; woodland group 11; irrigation group 6; and group 12 for building sites.

Duffield Series

The Duffield series consists of deep to moderately deep, well-drained soils. The surface layer of these soils is dark yellowish-brown silt loam. Their subsoil is yellowish-brown to strong-brown silt loam to silty clay loam.

These soils developed in place in material weathered from bluish-gray, impure limestone. They are gently rolling to steep and occupy broad areas in the central part of the county.

The Duffield soils are generally less deep than the Washington soils, which formed on glacial till of pre-Wisconsin age or on frost-churned material weathered from limestone.

Several soils that are similar to the Duffield soils, but that contain more silt and less clay, have been included with the Duffield series. These are called Duffield silt loams, low clay variant. These soils developed in material weathered from cement rock. They are deep, have a fairly uniform, yellowish-brown color, and are more friable than the typical Duffield soils. They also lack the well-developed textural and color B horizon of those soils.

Typical profile of Duffield silt loam, 8 to 15 percent slopes, moderately eroded, in a cultivated area:

- A_p 0 to 8 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; weak, fine, granular structure; friable when moist; neutral; abrupt, smooth boundary; 8 to 12 inches thick.
- A_3 8 to 14 inches, yellowish-brown (10YR 5/4) silty clay loam; weak, medium, subangular blocky structure and weak, medium, granular structure; friable when moist, slightly plastic when wet; neutral; clear, wavy boundary; 5 to 7 inches thick.
- B_{21} 14 to 27 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, medium, subangular blocky structure; friable when moist, slightly plastic when wet; distinct clay films on the surfaces of peds; neutral; gradual, wavy boundary; 7 to 14 inches thick.
- B_{22} 27 to 36 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, medium, subangular blocky structure; friable when moist; distinct clay films on the surfaces of peds; neutral; gradual, wavy boundary; 7 to 11 inches thick.
- B_{23} 36 to 42 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, fine and medium, subangular blocky structure; friable when moist; neutral; clear, irregular boundary; 4 to 8 inches thick.
- D_r 42 inches +, bluish-gray limestone.

The texture of the surface layer ranges from silt loam to fine silt loam, and that of the subsoil, from silt loam to silty clay loam.

Water moves through the profile moderately well. The soil has high available moisture capacity and is high in natural fertility.

Duffield silt loam, 0 to 3 percent slopes, moderately eroded (DuA2).—The profile of this soil is similar to the one described as typical for the series, but the solum is thicker. Although this soil is moderately eroded, it still has from one-fourth to three-fourths of its original surface layer. In some places this soil is in small, basinlike areas and soil material has accumulated on its surface.

This soil has moderate permeability in the subsoil and substratum. Its available moisture capacity and natural fertility are high.

This soil is excellent for all of the crops commonly grown in the county. It is used intensively for corn, potatoes, and small grains. Growing alfalfa and other legumes in rotation will help to improve its structure and to maintain a good supply of organic matter.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 1; and group 1 for building sites.

Duffield silt loam, 3 to 8 percent slopes, moderately eroded (DuB2).—The profile of this soil is similar to the one described as typical for the series, but the solum is somewhat thicker.

The permeability of the subsoil and underlying material in this soil is moderate. The available moisture capacity is high, and the soil is high in natural fertility.

This soil is excellent for the general farm crops commonly grown in the county. It is subject to erosion, however, if it is cultivated and not protected. Contour stripcropping and diversion terraces can be used to help control erosion in fields that are cultivated. Growing grasses and legumes in rotation will help to improve the structure of the soil and to maintain a good supply of organic matter.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 1; and group 1 for building sites.

Duffield silt loam, 8 to 15 percent slopes, moderately eroded (DuC2).—This soil has a profile like the one described for the series. It has retained from one-fourth to three-fourths of its original surface layer, although it is moderately eroded. The subsoil is yellowish-brown, uniform silty clay loam. There are only a few fragments of rock throughout the profile.

Surface runoff is medium to rapid on this soil, and the permeability of the subsoil and substratum is moderate. The available moisture capacity is high, and the soil is high in natural fertility.

This soil is well suited to the general crops commonly grown in the county. It is highly productive, but, if cultivated, it erodes easily. Contour stripcropping is needed on the long slopes to help control erosion. Diversion terraces can be used to dispose of excess surface water from the higher slopes. Using a rotation that includes hay crops will improve the structure of the soil and add organic matter.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 1; and group 2 for building sites.

Duffield silt loam, 15 to 25 percent slopes, moderately eroded (DuD2).—The profile of this soil is similar to the one described as typical for the series, except that the surface layer is thinner. This soil also has a greater number of rock fragments throughout the profile. The parent material is nearer the surface, and in some places rock outcrops are common.

The permeability of the subsoil and underlying material is moderate. The soil has high available moisture capacity, and it is moderate to high in natural fertility.

This soil can be used occasionally for cultivated crops, but it is better suited to hay, pasture, and trees. Alfalfa, red clover, ladino clover, timothy, orchardgrass, and bromegrass can be grown. When it is necessary to renovate the areas for hay crops, reseed in corn and winter grain and use contour stripcropping and diversion terraces. In this way erosion can be controlled.

This soil is in capability unit IVe–1; woodland group 5; irrigation group 1; and group 2 for building sites.

Duffield silt loam, 15 to 25 percent slopes, severely eroded (DuD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and the parent material and bedrock are nearer the surface. In places there are some outcrops of bedrock.

The soil has a moderately permeable subsoil and substratum. The available moisture capacity is moderately high, and natural fertility is moderate to high.

This soil is better suited to pasture and trees than to tilled crops. Alfalfa, red clover, ladino clover, timothy, orchardgrass, and bromegrass can be grown. If hay crops are grown, reseed by disking, and use contour stripcropping and diversion terraces to help control erosion.

This soil is in capability unit VIe–1; woodland group 6; irrigation group 1; and group 2 for building sites.

Duffield silt loam, 25 to 35 percent slopes, moderately eroded (DuE2).—The profile of this soil is similar to the one described for the series, but it is much shallower over bedrock and the surface layer contains more fragments of rock. Also, ledges and outcrops of rock are more common.

The subsoil and material underlying this soil are moderately permeable. The available moisture capacity is moderately high. Natural fertility is moderate.

This soil is better suited to pasture and trees than to tilled crops, and most of the areas are wooded. Alfalfa, ladino clover, timothy, orchardgrass, bromegrass, meadow fescue, alsike clover, white clover, and bluegrass can be grown.

This soil is in capability unit VIe–1; woodland group 7; irrigation group 1; and group 9 for building sites.

Duffield silt loam, 35 to 55 percent slopes, moderately eroded (DuF2).—This soil consists mostly of ledges and of rock outcrops. It is on very steep, narrow slopes that lie adjacent to streams.

This soil probably is best suited to trees grown for timber or to shrubs used to provide food and shelter for wildlife. All of the areas are idle or are wooded.

This soil is in capability unit VIIe–1; woodland group 7; irrigation group 1; and group 9 for building sites.

Duffield silt loam, low clay variant, 0 to 3 percent slopes (DvA).—The profile of this soil is like the one described as typical for the Duffield series, but the B horizon contains less clay, the profile is siltier throughout, and the parent material is at a greater depth. The surface layer of this soil is also somewhat thicker than that in the profile described, and the subsoil is more yellowish and has a slippery feel. This soil is nearly level. In some places it is in depressions and soil material from higher areas has accumulated on the surface.

Mapped with this soil are areas of moderately well drained Bedford silt loam. These included areas are too small to be mapped separately.

Duffield silt loam, low clay variant, 0 to 3 percent slopes, is excellent for the general farm crops commonly grown in the county. Growing grasses and legumes periodically helps to maintain the organic matter and soil structure. A row crop and a small grain can be grown in alternate years if a cover crop is left over winter following corn and a green-manure crop is grown following the small grain.

This soil is in capability unit I–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Duffield silt loam, low clay variant, 0 to 3 percent slopes, moderately eroded (DvA2).—The profile of this soil is like the one described as typical for the Duffield series, but the subsoil is coarser textured and more yellowish, and it has a slippery feel. In a few areas the soil is in depressions and silt has accumulated on the surface. There are also some small patches where much material from the subsoil has been mixed into the plow layer.

This soil is excellent for the farm crops generally grown in the county, but it is subject to erosion if it is cultivated continuously. Farming on the contour helps to reduce erosion and to conserve moisture. Growing grasses and legumes in the rotation helps to maintain the structure of the soil and the content of organic matter. A suitable rotation would be 1 year of a row crop, followed by 1 year of a small grain, and then 1 year of hay, or a similar rotation of medium intensity.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Duffield silt loam, low clay variant, 3 to 8 percent slopes (DvB).—The profile of this soil is like the one described as typical for the Duffield series, but the B horizon contains somewhat less clay and bedrock is at a greater depth. The subsoil is also lighter colored and coarser textured. The soil is on the lower parts of long, gentle

slopes and in small depressions. Soil material from higher areas has accumulated on the surface.

This soil is excellent for the general farm crops commonly grown in the county, but, if it is cultivated, it is subject to erosion. Contour stripcropping can be used to help reduce erosion. Diversion terraces can be used on the long slopes to remove excess surface water. Growing grasses and legumes in a rotation of medium intensity will help to control erosion. These plants also improve the structure of the soil and help maintain the content of organic matter.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Duffield silt loam, low clay variant, 3 to 8 percent slopes, moderately eroded (DvB2).—The profile of this soil is more silty and lighter colored, than the one described for the Duffield series, and parent material is at a somewhat greater depth. In some places material from the subsoil has been mixed into the plow layer, and in small areas the subsoil is exposed. Runoff is slow to medium on this gently sloping soil.

This soil is excellent for the general farm crops commonly grown in the county, but it erodes easily if it is cultivated and not protected. Growing legumes and grasses in a rotation of medium intensity helps to control erosion and to maintain organic matter in the soil. The legumes and grasses also help to improve the structure of the soil. Contour stripcropping and diversion terraces can be used to help control erosion, and they help to increase yields.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Elk Series

The Elk series consists of deep, well-drained soils of terraces. The soils have a dark-brown surface layer. In some places the profile contains gravel or cobbles.

These soils formed on high stream terraces in old alluvial deposits of sand, silt, and clay. The terraces are along streams that flow from valleys underlain by limestone, and they are higher than the present flood plains. Most areas of these soils are small.

The Elk soils are near the deep, well drained Huntington, the moderately well drained Lindside, and the poorly drained Melvin soils, which are all on the flood plains of streams in valleys underlain by limestone. They are less fertile than the associated soils because they are older and have been more leached.

Typical profile of Elk silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, moderate, granular structure; friable when moist, slightly sticky when wet; slightly acid; abrupt wavy boundary; 7 to 10 inches thick.

B_{21} 10 to 28 inches, yellowish-brown (10YR 5/4) heavy silt loam; moderate, medium, subangular blocky structure; friable when moist, slightly sticky when wet; slightly acid; gradual, wavy boundary; 10 to 18 inches thick.

B_{22} 28 to 40 inches, yellowish-brown (10YR 5/6) heavy silt loam; weak medium, subangular blocky structure; friable when moist, slightly sticky when wet; neutral; clear, wavy boundary; 10 to 16 inches thick.

B_3 40 to 58 inches, yellowish-brown (10YR 5/8) silt loam; weak, medium, subangular blocky structure; friable when moist, slightly sticky when wet; neutral; clear, wavy boundary; 12 to 18 inches thick.

C_1 58 to 62 inches +, brownish-yellow (10YR 6/6) coarse silt loam; weak, very fine, granular structure; friable when moist, slightly sticky when wet; neutral.

The texture of the Elk soils ranges from silt loam to fine sandy loam.

These soils have moderate permeability in the subsoil and substratum. Their available moisture capacity is high, and they are moderate in natural fertility.

Elk silt loam, 0 to 3 percent slopes (EkA).—This is the only Elk soil mapped in the county, and its profile is the one described for the series. The soil has retained nearly all of the original surface layer. Its subsoil is yellowish brown to brownish yellow. In some places the surface layer is thicker than that in the profile described because soil has rolled downslope onto the areas or has been deposited on them by local flooding. The profile in some places contains rounded pebbles. Runoff is slow to very slow on this soil. Nevertheless, the soil is subject to erosion.

Mapped with this soil are areas of a moderately well drained soil and a few areas of a soil that has a thinner surface layer and is slightly steeper than this soil. These included areas are too small to be mapped separately.

Elk silt loam, 0 to 3 percent slopes, is excellent for the general farm crops commonly grown in the county. Most of it is in crops.

Farming this soil on the contour or using contour stripcropping will help to control erosion and to conserve moisture. Diversion terraces can be used to help dispose of excess runoff from the nearby slopes. Growing grasses and legumes periodically will help to improve the structure of the soil and to maintain the supply of organic matter.

This soil is in capability unit I–1; woodland group 2; irrigation group 1; and group 1 for building sites.

Extremely Stony Land

This miscellaneous land type consists of steep, broken areas. The areas have little soil material and are not suited to agriculture.

Extremely stony land (Es).—This mapping unit is made up of steep, extremely stony areas on Blue Mountain. The areas consist of fields that are mostly boulders and of ledges that have little or no vegetation. The rocks are mainly sandstone, quartzite, and conglomerate of the Tuscarora formation. The quartzite is hard and is the most resistant to weathering of all the rocks in the county. There is little soil material between the rocks, and that on the steepest slopes is very shallow over bedrock.

These steep areas have little soil material on them, and the vegetation is sparse. Trees grow slowly and are generally too few in number to harvest economically. The areas are too steep for the use of modern logging implements. This mapping unit is best used for recreation and for protection of the watershed.

Extremely stony land is in capability unit VIIIs–1 and group 9 for building sites.

Fleetwood Series

The Fleetwood series consists of moderately deep to deep, well-drained, gravelly and stony soils of uplands. The surface layer of these soils is dark brown, and the subsoil is yellowish-brown to strong-brown gritty silty loam.

The Fleetwood soils in the southern part of the county formed in material weathered from quartzite. They are in scattered areas on ridges and hills of South Mountain, which is a part of the Reading upland. Those in the northern part formed in material weathered from sandstone, conglomerate, and quartzite, and they are on Blue Mountain. The Fleetwood soils on Blue Mountain are finer textured and browner than those on South Mountain.

The Fleetwood soils in the southern part of the county are generally near deep, well-drained Chester soils. They are also near moderately well drained Glenville, poorly drained Worsham, and shallow, well drained Brandywine soils. Those in the northern part of the county are near areas of Extremely stony land. In addition, they are near deep, well drained Laidig, moderately well drained Buchanan, and poorly drained Andover soils.

Typical profile of Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area:

A_p 0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly loam; 70 percent coarse fragments; weak, fine, granular structure; very friable when moist; neutral; clear, wavy boundary; 4 to 6 inches thick.

A_2 6 to 11 inches, brown (10YR 5/3) gravelly loam; 30 percent coarse fragments; weak, fine, subangular blocky structure; friable when moist; medium acid; clear, wavy boundary; 4 to 7 inches thick.

B_1 11 to 15 inches, yellowish-brown (10YR 5/4) gritty silt loam; 30 percent coarse fragments; weak, fine, subangular blocky structure; friable when moist; thin clay films on the surfaces of peds; strongly acid; clear, wavy boundary; 3 to 5 inches thick.

B_2 15 to 30 inches, strong-brown (7.5YR 5/6) gritty silty clay loam; 30 percent coarse fragments; weak, medium, subangular blocky structure; friable when moist, slightly sticky and plastic when wet; medium clay films on the surfaces of peds; strongly acid; gradual, wavy boundary; 10 to 18 inches thick.

B_3 30 to 40 inches, strong-brown (7.5YR 5/6) stony sandy loam; 70 percent coarse fragments from 2 inches to 2 feet in diameter; weak, medium, granular structure; friable when moist; strongly acid; gradual, wavy boundary; 8 to 12 inches thick.

C_1 40 inches +, brown (10YR 5/3) stony sandy loam; 90 percent coarse fragments; weak, medium, granular structure; friable when moist, slightly sticky when wet; strongly acid; 3 feet or more thick.

The profile of these soils is 24 to 60 inches thick. The subsoil is yellowish brown to strong brown, and its texture ranges from gravelly loam to gravelly silty clay loam. Angular stones that range from 4 inches to several feet in diameter are common, but on steep areas the stones are much larger.

These soils have moderately rapid permeability in the subsoil and substratum. Their water-holding capacity is moderate, but they are low in natural plant nutrients.

Most areas of Fleetwood soils are stony. The soils are excellent for orchards, but they are only fair for farm crops. Most of the acreage is wooded or is in pasture.

Fleetwood gravelly loam, 3 to 8 percent slopes, moderately eroded (FgB2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is gravelly silt loam that, in some places, grades to sandy gravelly loam. The subsoil is generally gritty or gravelly silt loam, but in some places it is gravelly clay loam. Runoff is medium on this gentle sloping soil.

This soil is excellent for orchards and woodland. It is fairly well suited to the farm crops commonly grown in the county, but it erodes readily if it is used for cultivated crops.

Contour stripcropping can be used to help control erosion on this soil and to conserve moisture and plant nutrients. Diversion terraces will help to remove excess surface water. Growing grasses and legumes regularly in the rotation will improve the structure of the soil and will help maintain the supply of organic matter.

This soil is in capability unit IIe–3; woodland group 1; irrigation group 1; and group 1 for building sites.

Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded (FgC2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is somewhat thinner and contains more gravel. Also, the subsoil contains more grit.

Mapped with this soil are areas of a Chester soil that is moderately sloping. The included areas are too small to be mapped separately.

Fleetwood gravelly loam, 8 to 15 percent slopes, moderately eroded, is fairly well suited to the general farm crops grown in the county. It is excellent for orchards and good for woodland.

If tilled crops are grown on this soil, practices are needed to prevent further erosion. Diversion terraces and contour stripcropping can be used to help control erosion and to conserve moisture. Growing grasses and legumes periodically improves the structure of the soil and helps maintain the content of organic matter. Lime and fertilizer are needed for high yields.

This soil is in capability unit IIIe–3; woodland group 4; irrigation group 1; and group 2 for building sites.

Fleetwood gravelly loam, 8 to 15 percent slopes, severely eroded (FgC3).—The profile of this soil is like the one described as typical for the series, but it is lighter colored and thinner, and a large amount of material from the subsoil has been mixed into it. The profile also contains more gravel and is more sandy.

This soil is better suited to hay, pasture, and trees than to tilled crops. Lime and fertilizer are generally required, however, to establish the hay crop and to maintain good yields. Crops can be grown periodically to help reseed hay or pasture. When reseeding is done, contour strips are needed to help control erosion and to help conserve moisture. Diversions can be used on the long slopes to remove excess surface water and thus to protect the soil.

This soil is in capability unit IVe–3; woodland group 6; irrigation group 1; and group 2 for building sites.

Fleetwood gravelly loam, 15 to 25 percent slopes, moderately eroded (FgD2).—The profile of this soil is like the one described as typical for the series, but the surface layer contains more grit and is coarse textured. The surface layer and subsoil also contain more gravel and fragments of rock. In some places soil material has accumulated on the surface of this soil as the result of downhill creep. The soil is strongly sloping and is subject to severe erosion if it is cultivated.

This soil is better suited to hay, pasture, and trees than to tilled crops, but a tilled crop can be grown occasionally when hay or pasture needs reseeding. Lime and fertilizer are generally required to establish the hay crop and to maintain good yields. Reseeding in contour strips will help to reduce erosion. Diversion terraces can be used to dispose of excess surface water if the areas are suitable for building them.

This soil is in capability unit IVe–3; woodland group 4; irrigation group 1; and group 2 for building sites.

Fleetwood gravelly loam, 15 to 25 percent slopes, severely eroded (FgD3).—The profile of this soil is similar to the one described as typical for the series, but it is more sandy and gravelly throughout. Also, the surface layer is thinner and contains larger fragments of rock. In some places all of the original surface layer has been lost, the former subsoil is exposed, and there are small gullies.

This soil is better suited to pasture and trees than to other uses. It is suited to all of the grasses and legumes commonly grown in this area, but fertilizer and lime need to be applied frequently to get good yields of pasture. Contour strips should be used when the pastures are reseeded. In areas where they can be built conveniently, diversion terraces can be used to help control runoff on long slopes.

This soil is in capability unit VIe–2; woodland group 6; irrigation group 1; and group 2 for building sites.

Fleetwood gravelly loam, 25 to 35 percent slopes, moderately eroded (FgE2).—The profile of this soil is similar to the one described as typical for the series, but it is sandier, contains coarser textured material including more gravel, and is somewhat shallower over bedrock. In some places the former subsoil is exposed and there are small gullies.

This soil is mainly in pasture or is idle, but small areas are in orchards. The soil is well suited to use for woodland.

This soil is in capability unit VIe–2; woodland group 7; irrigation group 1; and group 9 for building sites.

Fleetwood very stony loam, 0 to 8 percent slopes (FhB).—The profile of this soil is similar to the one described as typical for the series, but it has boulders of quartzite and sandstone throughout and scattered on the surface. In wooded areas a thin layer of black organic matter, ½ inch to 1½ inches thick, is on the surface. The A_2 horizon in wooded areas is thicker than that in areas that are cultivated, and it is brown or yellowish brown. This soil is level to gently sloping. It has slow to moderate runoff.

All of this soil is wooded or idle, and, if cleared, it would furnish only a limited amount of pasture. The areas are generally better used for trees and for habitats for wildlife than for other uses. The large boulders and excessive number of stones generally make the soil difficult to clear for crops or pasture. The trees on this soil have been cut over several times.

This soil is in capability unit VIs–1; woodland group 1; and group 5 for building sites.

Fleetwood very stony loam, 8 to 25 percent slopes (FhD).—This soil has large boulders of sandstone and quartzite on the surface and throughout the profile. The profile is shallower over bedrock than that of the Fleetwood gravelly loam described for the series, and in some places it contains more grit and sand. This soil is moderately sloping to strongly sloping. It is mainly on the sides of South Mountain and other ridges in the southern part of the county.

All of the acreage is in trees. The soil could provide limited amounts of pasture if it were cleared, but the location and the stones limit its use to trees and to providing habitats for wildlife.

This soil is in capability unit VIs–1; woodland group 4; and group 6 for building sites.

Fleetwood very stony loam, 25 to 60 percent slopes (FhF).—The profile of this soil is like the one described for the series, but it is shallower over bedrock and has larger boulders on and near the surface. The profile also contains more fragments of sandstone. This steep or very steep soil is on the sides of Blue Mountain and South Mountain, and it is also on high ridges in the southern part of the county.

Mapped with this soil are some areas of Extremely stony land that are too small to be mapped separately.

The stones, steep slopes, and shallow profile make Fleetwood very stony loam, 25 to 60 percent slopes, impractical to clear for pasture or crops. The soil is probably best suited to trees or to provide habitats for wildlife. All of it is wooded, but most of the large trees have been cut for lumber.

This soil is in capability unit VIIs–1; woodland group 7; and group 9 for building sites.

Glenville Series

The Glenville series consists of deep, moderately well drained to somewhat poorly drained soils of uplands. The soils have a surface layer of dark grayish-brown silt loam. Their subsoil is strong-brown to yellowish-brown silty clay loam that is mottled with brownish gray at a depth between 28 and 30 inches.

These soils formed in materials from granite, granite gneiss, and gneiss. They are on the lower slopes of ridges and in drainageways in the southern part of the county where seepage causes the water table to rise during wet periods. The soils are level to moderately sloping.

In many places the Glenville soils are near the deep, well-drained Chester soils. They are also near the shallow Brandywine, the poorly drained Worsham, and the very poorly drained Woodglen soils. All of these soils formed in similar parent material.

Typical profile of Glenville silt loam, 0 to 3 percent slopes, moderately eroded, in a cultivated area:

- A_p 0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable when moist, nonsticky when wet; medium acid; abrupt, wavy boundary; 5 to 7 inches thick.
- B_{21} 6 to 12 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium to coarse, subangular blocky structure; firm when moist, sticky when wet; thin, discontinuous coatings of clay on the surfaces of peds; medium acid; gradual, wavy boundary; 5 to 8 inches thick.
- B_{22} 12 to 20 inches, brown (7.5YR 5/4) silty clay loam; strong, coarse, angular blocky structure; firm when moist, very sticky when wet; medium acid; gradual, wavy boundary; 7 to 11 inches thick.
- B_{3g} 20 to 30 inches, yellowish-brown (10YR 5/6) silty clay loam mottled with light brownish gray (10YR 6/2); strong, coarse, angular blocky structure; firm when moist, very sticky and plastic when wet; medium acid; gradual, wavy boundary; 9 to 12 inches thick.
- C_r 30 inches +, brown (7.5YR 5/4), yellowish-brown (10YR 5/6), or strong-brown (7.5YR 5/6), partly weathered granite and gneiss; the proportion of coarse fragments is high.

In most places the subsoil is mottled at a depth between 26 and 34 inches, but in some small areas mottling is at a depth of 18 inches. The texture of the subsoil ranges from gritty silt loam to gravelly clay loam.

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The permeability of the subsoil and substratum of these soils is moderately slow, and the available moisture capacity is high. The soils are medium in natural fertility. The water table is moderately high as the result of seepage, and the slowly permeable substratum restricts drainage. Consequently, during wet periods the surface layer is soft and spongy and the soil is difficult to till. Small areas of a poorly drained soil are included within areas of the Glenville soils, and these areas often affect management. They are too small to be mapped separately.

Glenville silt loam, 0 to 3 percent slopes (GnA).—The surface layer of this soil is thicker than that of the profile described as typical for the series. This soil has retained nearly all of its original surface layer. In the lower part of the subsoil, there is a tight, clayey layer that impedes drainage. In some places soil material, washed from higher areas, has accumulated on the surface. Runoff is slow to very slow on this soil, and erosion has been slight. Most of this soil is wooded or in pasture.

This soil is fairly will suited to the general farm crops commonly grown in the county, but alfalfa and small grains are likely to freeze out in winter. In many places tile drains have been installed to remove the excess water and thus increase yields.

This soil is in capability unit IIw–1; woodland group 9; irrigation group 4; and group 10 for building sites.

Glenville silt loam, 0 to 3 percent slopes, moderately eroded (GnA2).—This soil has a profile like the one described as typical for the series. Although it is moderately eroded, one-fourth to three-fourths of its original surface layer remains. This soil contains a few fragments of granite, gneiss, and quartzite. It is mottled in the lower part of the subsoil below a depth of about 20 inches. Runoff is slow to very slow.

This soil is fairly well suited to the general farm crops commonly grown in the county, but small grains are generally damaged by heaving in winter. Corn grows very well in years when rainfall is not excessive. Wetness sometimes delays the plowing of adjacent well-drained soils.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Glenville silt loam, 3 to 8 percent slopes (GnB).—The surface layer of this soil is thicker than that in the profile described as typical of the series, and it is also more silty and contains fewer fragments of rock. In places, near the bottom of slopes, soil material from higher areas has accumulated on the surface.

Runoff is slow to medium on this sloping soil. Erosion has been slight. Most of this soil is wooded, but it is fairly well suited to general farm crops. Small grains and other crops are likely to freeze out, however, because of the excess moisture in winter. In some places drainage could be improved by installing tile underdrains.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Glenville silt loam, 3 to 8 percent slopes, moderately eroded (GnB2).—The profile of this soil is shallower over partly weathered granite and gneiss than the profile described as typical for the series. A greater number of rock fragments are on the surface. In some places erosion has been severe and there are small rills and gullies. Runoff is slow to medium.

This soil is fair for the crops commonly grown in the county. Yields could be improved by installing tile underdrains, and erosion could be reduced by using diversion terraces. Growing legumes and grasses in longer rotations will improve the structure of the soil and also reduce erosion. Grasses and legumes that tolerate wetness should be used.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Glenville silt loam, 8 to 15 percent slopes (GnC).—The surface layer of this soil is somewhat coarser textured than that in the typical profile described, and there are more fragments of rock throughout the profile. This soil is only slightly eroded, but in a few places a small amount of soil material from higher areas has accumulated on the surface. Runoff is medium to rapid.

This soil is fair for the crops commonly grown in the county, but in some places tile drains can be used to help improve yields. Graded stripcropping will help control erosion. Diversion terraces are needed in places on the higher slopes to help remove excess surface water and to reduce erosion.

This soil is in capability unit IIIe–4; woodland group 10; irrigation group 4; and group 11 for building sites.

Glenville silt loam, 8 to 15 percent slopes, moderately eroded (GnC2).—The profile of this soil is like the profile described for the series, but its surface layer is thinner. From one-fourth to three-fourths of the original surface layer has been lost through erosion. The soil material in the surface layer is mixed with varying amounts of material from the subsoil, and it is somewhat lighter colored than that of the profile described as typical of the series. Erosion has caused small gullies and rills to form. Early in spring, this soil is generally too wet to be plowed. Runoff is medium to rapid.

This soil is fair for the crops commonly grown in the county. Using tile to drain the seep spots will improve drainage and permit the soil to be tilled earlier in spring. If the soil is used for row crops, graded strips are needed to prevent further erosion. Diversion terraces can be used on the long slopes to help control runoff.

This soil is in capability unit IIIe–4; woodland group 10; irrigation group 4; and group 11 for building sites.

Huntington Series

The Huntington series is made up of deep, well-drained soils of the flood plains. The soils have a dark grayish-brown surface layer, and their subsoil is yellowish-brown to dark-brown silty clay loam or silt loam.

The Huntington soils consist of recent alluvium washed from soils on uplands underlain by limestone. They are in low, flat areas adjacent to streams and are in limestone valleys in the central part of the county. The soils are subject to occasional flooding.

These soils are generally near deep, moderately well drained Lindside and poorly drained Melvin soils of the flood plains. They are also near deep, well-drained Washington soils of the uplands.

Typical profile of Huntington silt loam in a cultivated area:

A_p 0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, granular structure; friable when moist; neutral; abrupt boundary; 9 to 12 inches thick.

C_1 11 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; weak, medium, subangular blocky structure; friable when moist; thin clay films on the surfaces of peds; neutral; clear, wavy boundary; 6 to 10 inches thick.

C_2 18 to 38 inches, brown (10YR 5/3) shaly silt loam; weak, fine, granular structure; friable when moist; neutral; gradual, wavy boundary; 15 to 20 inches thick.

C_3 38 inches +, light yellowish-brown (10YR 6/4) shaly silt loam; weak, fine, granular structure; friable when moist; slightly acid.

The color of the surface layer ranges from grayish brown to very dark brown, and that of the subsoil, from yellowish brown to dark brown. The texture of the subsoil ranges from fine shaly silt loam to silty clay loam.

These soils have moderate to rapid permeability in the subsoil and substratum. They have high water-holding capacity and are high in natural fertility.

Huntington silt loam (Hn).—This is the only Huntington soil mapped in the county. Its profile is like the one described as typical for the series. The soil has a dark-brown, silty surface layer. In some places the profile contains a few rounded cobbles of sandstone and quartzite. The upper part of the subsoil is dark-brown, porous silt loam, but the lower part is silty clay loam. At a depth between 28 and 40 inches, the subsoil contains medium-sized fragments of shale, gravel, and sand.

This soil is well suited to vegetables and to the general farm crops commonly grown in the county. It is excellent for pasture; all the grasses and legumes common to the area grow well on this soil.

This soil is in capability unit I–3; woodland group 2; irrigation group 1; and group 13 for building sites.

Klinesville Series

The Klinesville series consists of shaly, well-drained soils that have shale near the surface. The surface layer of these soils is dark reddish brown and contains many coarse fragments of shale. The subsoil is yellowish-red to red shaly silt loam. These soils formed in material weathered from red shale of the Martinsburg formation. They are on ridges in the northwestern part of the county. The slopes are gentle to steep.

These soils are near the well-drained Montevallo soils, which are shallow over dark-gray shale. They are also near the deep, well drained Trexler, the moderately well drained to somewhat poorly drained Comly, and the poorly drained Shelmadine soils.

Typical profile of Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded, in a cultivated area:

A_p 0 to 6 inches, dark reddish-brown (5YR 3/2) shaly silt loam; 20 percent shale fragments; weak, fine, granular structure; friable when moist, nonsticky when wet; moderately acid; abrupt, irregular boundary; 2 to 7 inches thick.

B_3 6 to 12 inches, reddish-brown (5YR 4/4) very shaly silt loam; 60 percent shale fragments; fine, granular structure; friable when moist, slightly sticky when wet; moderately acid; gradual, wavy boundary; 5 to 8 inches thick.

C_1 12 to 20 inches, red (2.5YR 4/6) very shaly silt loam; 85 percent coarse fragments; weak, fine, granular structure; friable when moist, nonsticky when wet; strongly acid; abrupt, wavy boundary; 4 to 12 inches thick.

D_r 20 inches +, thin-bedded, hard, reddish-brown (2.5YR 3/4) shale.

The color of the soil material below the surface layer ranges from yellowish red to red, and its texture, from shaly silt loam to gravelly silt loam. In some places glacial material is mixed in these soils.

These soils have low to very low available moisture capacity, and they are likely to be droughty. The permeability of the subsoil is moderately rapid. The soils are fairly well suited to potatoes and orchards.

Klinesville shaly silt loam, 3 to 8 percent slopes, moderately eroded (KnB2).—The profile of this soil is similar to the profile described as typical for the series, but the surface layer is thicker and contains fewer fragments of shale and rock. Also, the fragments of shale in the profile are smaller. In some small, wooded areas, the soil has been only slightly eroded.

Mapped with this soil are some small areas where soil material has washed from higher slopes and accumulated on the surface. These included areas are too small to be mapped separately.

Klinesville shaly silt loam, 3 to 8 percent slopes, modately eroded, is satisfactory for potatoes and orchards, and it is fairly well suited to other crops commonly grown in the county. If cultivated, this soil erodes easily. Contour stripcropping can be used to help protect it from further erosion and to conserve moisture. Growing grasses and legumes periodically will improve the structure of the soil and add organic matter. Diversion terraces can be used to remove excess surface water.

This soil is in capability unit IIIe–3; woodland group 12; irrigation group 7; and group 7 for building sites.

Klinesville shaly silt loam, 8 to 15 percent slopes, moderately eroded (KnC2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is somewhat thicker and contains fewer fragments of shale and sandstone. Also, erosion has been less severe. In some small, wooded areas, this soil has been only slightly eroded. In places glacial material is mixed with the soil.

This soil is fairly well suited to crops, but it erodes easily if it is cultivated. Growing grasses and legumes for long periods will help to control erosion. Contour stripcropping will also help to control erosion and will help to conserve water. Diversion terraces can be used to dispose of excess surface water.

This soil is in capability unit IVe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Klinesville shaly silt loam, 15 to 25 percent slopes, severely eroded (KnD3).—The profile of this soil is like the profile described as typical for the series. The surface layer is thin and contains concentrations of shale fragments. In most places the bedrock is near the surface and the plow layer is more reddish than that of the profile described. In small areas the soil is only slightly eroded.

The steep slopes, low available moisture capacity and fertility, and the risk of further erosion make this soil better suited to trees than to tilled crops or pasture.

This soil is in capability unit VIIe–2; woodland group 14; irrigation group 7; and group 8 for building sites.

Klinesville shaly silt loam, 25 to 35 percent slopes, severely eroded (KnE3).—The profile of this soil is similar to the one described for the series, but the surface layer is thin and contains many fairly fresh, hard fragments of shale. In most places bedrock is near the surface. In some places the soil is only slightly eroded.

This soil is unsuited to cultivation. It is probably best suited to trees grown for timber or to trees and shrubs grown to provide food and cover for wildlife.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Laidig Series

The Laidig series is made up of deep, well-drained soils that commonly have many stones and boulders on the surface. In forested areas these soils have a thin, black layer of organic matter on the surface and a light yellowish-brown, mineral surface layer. Their subsoil is strong brown or red and has a fairly dense fragipan. The fragipan restricts the depth to which roots can penetrate, and it sometimes retards the movement of water through the soil.

These soils formed in material that accumulated at the foot of Blue Mountain. They are in the northern part of the county.

The Laidig soils are near the moderately well drained Buchanan soils and the poorly drained Andover soils. In some places they are near the deep Trexler soils, and in places they are near the Montevallo soils, which are shallow over dark-gray shale.

Typical profile of Laidig very stony loam, 8 to 25 percent slopes:

- A_1 0 to 2 inches, very dark gray (10YR 3/1) loam; 60 percent coarse fragments; weak, fine, granular structure; loose when moist, nonsticky when wet; slightly acid; abrupt, irregular boundary; 1 to 3 inches thick.
- A_2 2 to 13 inches, light yellowish-brown (10YR 6/4) silt loam; 40 percent coarse fragments; weak, medium, subangular blocky structure; friable when moist, slightly sticky when wet; strongly acid; clear, wavy boundary; 10 to 12 inches thick.
- B_{21} 13 to 22 inches, reddish-yellow (7.5YR 6/6) sandy clay loam; 35 percent coarse fragments; moderate, medium, subangular blocky structure that breaks to platy; firm when moist, sticky when wet; strongly acid; gradual, wavy boundary; 8 to 13 inches thick.
- B_{22} 22 to 40 inches, strong-brown (7.5YR 5/8) sandy clay loam; 60 percent coarse fragments; moderate, medium, subangular blocky structure that breaks to thin, platy; firm when moist, sticky when wet; very strongly acid; abrupt, irregular boundary; 15 to 20 inches thick.
- B_{23} 40 to 55 inches, yellowish-red (5YR 5/6) sandy clay loam; 45 percent coarse fragments; strong, coarse, subangular blocky structure; very firm when moist, very sticky when wet; very strongly acid; gradual, wavy boundary; 10 to 15 inches thick.
- C_1 55 inches +, red (2.5YR 4/8) gravelly silty clay loam; 60 percent fragments of sandstone and shale that are 1 to 6 inches in diameter; moderate, fine, blocky structure; very firm; very strongly acid; 12 or more inches thick.

The color of the subsoil ranges from yellowish brown to red, and the texture of the subsoil, from loam to silty clay loam. The stones and boulders on the surface range from 6 inches to 7 feet in diameter. These soils are moderate to low in natural fertility. They have moderate to high moisture-holding capacity and moderate permeability.

Most of the Laidig soils are wooded. The stones make it impractical to clear the soils for agriculture.

Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded (LaB2).—This soil has been cleared of trees and stones. Its profile is similar to the one described as typical for the series, but the thin, black layer of organic matter has been mixed into the surface layer by plowing. In small areas this soil is only slightly eroded.

Mapped with this soil are small areas in which the soil has shale mixed with the gravel.

Laidig gravelly loam, 3 to 8 percent slopes, moderately eroded, is well suited to the crops commonly grown in the county, but, if it is used for cultivated crops, it is subject to erosion.

Growing grasses and legumes will improve the structure and will add organic matter. Contour stripcropping can be used to help control erosion and to conserve moisture. Diversion terraces can be used, where feasible, to dispose of excess surface water.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 2; and group 3 for building sites.

Laidig very stony loam, 0 to 8 percent slopes (LdB).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thicker. It also contains fewer large boulders, but it is gravelly in places.

This soil would provide some pasture if it were cleared, but it is impractical to clear the areas because of their location and the number of stones. Consequently, this soil is best used as woodland or for wildlife. On most of the acreage, the trees have been cut several times for timber.

This soil is in capability unit VIs–1; woodland group 1; and group 3 for building sites.

Laidig very stony loam, 8 to 25 percent slopes (LdD).—The profile of this soil is like the profile described as typical for the series. Large pieces of sandstone and conglomerate are on the surface and throughout the profile. Also on the surface is a thin, black layer of organic matter, and in some places there are small, white pebbles of quartz.

All of this soil is wooded, and it is impractical to use it for farming. The soil is probably best suited to trees. Even if it were cleared and the areas used for grazing, the pastures would be of low quality.

This soil is in capability unit VIs–1; woodland group 4; and group 4 for building sites.

Lawrence Series

The Lawrence series consists of deep soils that are somewhat poorly drained. These soils formed in material weathered from limestone and cement rock. Their surface layer is dark grayish-brown silt loam. It is underlain by light-gray to grayish-brown silty clay loam that has distinct yellow and orange streaks and blotches.

These soils are in lower positions than the Bedford soils and receive more runoff. They are, therefore, less well drained than the Bedford soils.

Typical profile of Lawrence silt loam, 0 to 3 percent slopes, in a cultivated area:

- A_p 0 to 10 inches, dark grayish-brown (2.5Y 4/2) silt loam; weak, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary; 7 to 10 inches thick.
- B_{21g} 10 to 21 inches, very pale brown (10YR 7/3) silty clay loam; a few, fine, faint mottles of yellow (10YR 7/6) and light gray (10YR 7/2); moderate, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary; 7 to 12 inches thick.
- B_{22g} 21 to 30 inches, light-gray (10YR 7/2) silty clay loam; common, medium, distinct mottles of yellow (10YR 7/6); moderate, medium, subangular blocky struc-

ture; firm; neutral; gradual, wavy boundary; 7 to 10 inches thick.

B_{23g} 30 to 40 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, prominent mottles of strong brown (7.5YR 5/6), white (10YR 8/2), and brownish yellow (10YR 6/8); moderate, medium to coarse, blocky structure; firm; 10 to 15 inches thick.

These soils have a high water table. They are poorly suited to alfalfa, winter grains, potatoes, or other crops that cannot tolerate wetness.

In Lehigh County the Lawrence soils occupy small areas that are intermingled with areas of Bedford soils. Therefore, they are mapped only with Bedford soils in undifferentiated units that are called Bedford and Lawrence silt loams. The descriptions of these mapping units follow the description of the Bedford soils in this report.

Lindside Series

The Lindside series consists of deep, moderately well drained soils of flood plains. These soils have a surface layer that is dark grayish brown or dark brown. Their subsoil is yellowish brown to reddish yellow and is mottled in the lower part.

The soils consist of recent alluvium washed from uplands underlain by limestone. They are in low, flat areas adjacent to streams. The areas are in limestone valleys in the central part of the county, where they are subject to occasional flooding.

Most of these soils are near the deep, well drained Huntington, the poorly drained Melvin, and the moderately well drained Bedford soils. They are also near the deep, well-drained Washington, the moderately deep to deep Duffield, and the Ryder soils.

Typical profile of Lindside silt loam in a cultivated area:

A_p 0 to 12 inches, dark-brown (10YR 3/3) silt loam; weak, fine, granular structure; friable when moist, nonsticky when wet; slightly acid; clear, wavy boundary; 10 to 13 inches thick.

C_1 12 to 24 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium to coarse, subangular blocky structure; friable when moist, sticky when wet; neutral; abrupt, wavy boundary; 11 to 13 inches thick.

C_2 24 to 32 inches, yellow (10YR 8/6) silt loam that is mottled with very pale brown (10YR 8/4); weak, coarse, subangular blocky structure that breaks to thin, platy; friable when moist, sticky when wet; neutral; clear, wavy boundary; 7 to 10 inches thick.

C_3 32 to 40 inches +, reddish-yellow (7.5YR 7/8) silty clay loam that is mottled with pinkish gray (7.5YR 6/2); weak, medium, subangular blocky structure; friable when moist, very sticky when wet; neutral; 7 inches or more thick.

The color of the soil material below the surface layer ranges from yellowish brown to reddish yellow, and its texture, from silty clay loam to stratified sandy loam. Depth to mottling ranges from 24 to 36 inches.

Most of the acreage of Lindside soils is used for crops, but a few areas are used for pasture or as woodland. The soils have moderate permeability and high available moisture capacity.

Lindside silt loam (Ln).—This is the only Lindside soil mapped in the county. Its profile is like the one described as typical for the series. The surface layer is silty, and in a few places gravel is mixed into it. Internal drainage is slow, and there are pinkish-gray mottles in the lower part of the subsoil.

Mapped with this soil are areas of a poorly drained soil that are too small to be mapped separately.

Lindside silt loam is fairly well suited to the general farm crops grown in the county. In spring the soil is wet and the growth of plants is retarded. Small grains are generally winterkilled. Tile drains or bedding can be used, if feasible, to improve the drainage and to make the soil more favorable for the growth of plants.

This soil is in capability unit IIw–2; woodland group 9; irrigation group 1; and group 13 for building sites.

Made Land

Made land consists of quarries or of large areas where a soil has been covered by other materials. It also consists of areas where the soil material has been moved about to provide materials for the building of cities and airports, or has been used in land-fill operations, or other industrial development.

In some places the material has been leveled, but the kind of soil material and slope make use of the areas impractical for agriculture. In these places the texture, structure, and fertility of the soil material vary widely.

On the southern side of the limestone valley, there are large areas of Made land where iron ore was mined by shallow stripping in the 19th century. Some of these areas have been leveled and farmed. The soils there have a plow layer that is stained with organic matter, but they lack definite horizons below that layer. Nevertheless, they are highly productive.

In many places the areas consist of coarse-textured or rocky material and have little soil material. These areas are generally not suited to farming. In some places there are slate dumps and other areas that are generally unsuited to plants; included in those areas, however, are some areas that are suitable for plants and that should have a protective cover of vegetation.

Soil conditions are extremely variable and difficult to predict. Individual site determinations are needed for most uses.

Made land, granitic material, 0 to 8 percent slopes (MaB).—In places the surface layer of this mapping unit has been removed. In other places it has been thoroughly mixed with or completely covered by material that was formerly part of the subsoil and by fragments of granite gneiss rock. The present surface layer is gravelly or stony spoil material from granite and sandstone quarries.

This mapping unit is nearly level to sloping and is adjacent to quarries. Some areas are in sites where the profile of the normal soil has been altered by urban or industrial development.

None of this mapping unit is used for agriculture. Practices would be needed to control erosion if the areas were farmed. Growing grasses and legumes improves the structure of the soil material and increases the supply of organic matter.

This mapping unit is in capability unit IIe–2 and in group 1 for building sites.

Made land, granitic material, 8 to 25 percent slopes (MaD).—This mapping unit is somewhat steeper than Made land, granitic material, 0 to 8 percent slopes, but it is otherwise similar. Most of it consists of steep areas of old spoil from adjacent sandstone and granite quarries.

Growing grasses and legumes on the areas will provide cover and help control erosion. In some places intensive practices are needed to conserve the soil and to stabilize the slope.

This mapping unit is in capability unit IVe–2 and group 2 for building sites.

Made land, limestone material, 0 to 3 percent slopes (MeA).—The surface layer of this unit has been thoroughly mixed with or completely covered by material that was formerly part of the subsoil and by fragments of limestone. Much of the material is overburden from quarries and has been leveled. In the areas that have been smoothed by farming and that have been farmed for approximately 100 years, the soil material is about as productive as that of the Washington soil that has similar slopes.

Growing grasses and legumes on the area in long rotations will improve the structure of the soil and add organic matter. Lime and fertilizer are needed to establish and to maintain good growth of plants. Plowing on the contour will help to control erosion.

This mapping unit is in capability unit IIe–1 and group 1 for building sites.

Made land, limestone material, 3 to 8 percent slopes (MeB).—This mapping unit is similar to Made land, limestone material, 0 to 3 percent slopes, but the areas are somewhat steeper and the surface layer contains more fragments of rock.

This mapping unit is suited to the crops commonly grown in the county, but it is likely to erode if it is cultivated.

Grasses and legumes should be grown in long rotations to improve the structure of the soil material and to add organic matter. Contour stripcropping can be used to help control erosion and to conserve moisture. Diversion terraces can be used on long slopes.

This mapping unit is in capability unit IIe–1 and group 1 for building sites.

Made land, limestone material, 8 to 25 percent slopes (MeD).—This mapping unit is similar to Made land, limestone material, 0 to 3 percent slopes, but it has steeper slopes. It consists of spoil material from adjacent, large limestone quarries. The surface layer generally has been removed, or material from the subsoil and parent material is mixed into it. Most areas are idle because of the rough, stony surface and steep slope. In places the areas can be stabilized by planting grass, legumes, shrubs, and trees.

This mapping unit is in capability unit IVe–1 and group 2 for building sites.

Made land, shale material, 0 to 8 percent slopes (MfB).—The surface layer of this soil is thoroughly mixed with and partially covered by slabs of slate and overburden from quarries. Most of this unit is near slate quarries, and slate from the quarries has been dumped on the areas. The areas are nearly level to gently sloping.

This mapping unit is in capability unit IIe–3 and group 5 for building sites.

Made land, shale material, 8 to 25 percent slopes (MfD).—This mapping unit is similar to Made land, shale material, 0 to 8 percent slopes, but it is steeper and has more slate and fragments of slate. It consists of spoilbanks and piles of material near slate quarries.

Most areas are too steep to farm or are otherwise unsuitable for farming. The areas that have been smoothed and that have been farmed for approximately 100 years are about as productive as the normal Trexler or Washington soils of similar slopes, and they require about the same management. Some of the areas can be stabilized by planting grasses, legumes, shrubs, and trees on them.

This mapping unit is in capability unit IVe–2 and group 6 for building sites.

Melvin Series

The Melvin series is made up of poorly drained soils of flood plains. Some of the soils are in low, flat areas where they formed in recent alluvium washed from areas underlain by limestone. These low areas are adjacent to streams in the central part of the county, and they are flooded occasionally early in spring and in summer. In some places the Melvin soils are in drainageways, in narrow valleys, around the heads of springs, and in depressions where water accumulates because there are no outlets. In those areas they formed in local colluvium and alluvium that washed onto the areas from adjacent uplands underlain by limestone.

The Melvin soils have a very dark grayish-brown surface layer. Their subsoil is dark grayish brown to gray and has many mottles. The surface layer of these soils in the drainageways, narrow valleys, around the heads of springs, and in depressions is thicker and more silty than that of the other Melvin soils. All of the areas are small.

Most of these soils are near the deep, well drained Huntington and moderately well drained Lindside soils of flood plains. They are also near the Washington, Duffield, Ryder, Bedford, and Lawrence soils of the uplands.

Typical profile of Melvin silt loam in a cultivated area:

A_p 0 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable when moist, nonsticky when wet; neutral; clear, wavy boundary; 10 to 15 inches thick.

B_{2gm} 12 to 18 inches, gray (N 5/0) silty clay loam; strong, coarse, blocky structure; very firm when moist, very sticky when wet; neutral; abrupt, wavy boundary; 5 to 9 inches thick.

B_{3gm} 18 to 36 inches, light-gray (10YR 7/1) silty clay loam that is mottled with brownish yellow (10YR 6/8); strong, coarse, blocky structure; very firm when moist, very sticky when wet; neutral; clear, wavy boundary; 14 to 18 inches thick.

C_{1m} 36 inches +, light-gray (10YR 7/1) gravelly silty clay loam; weak, medium, granular structure; very firm; neutral; 36 inches or more thick.

The surface layer is mottled, and there are mottles throughout the profile. The color of the subsoil ranges from dark grayish brown, through yellowish brown, to gray. The solum is gravelly fine sandy loam to clay loam.

These soils have moderately slow permeability in the subsoil and substratum. Their water-holding capacity is high, and they are high in natural fertility.

The Melvin soils are generally used for pasture or hay, but some small areas are in trees. Unless the soils are drained, they are suitable only for plants that tolerate wetness.

Melvin silt loam (Mh).—The profile of this soil is like the one described for the series. In some places the surface layer contains accumulations of silt or other material that was deposited by floodwaters or by water that moved down the long slopes above the flood plain. In places the soil contains appreciable amounts of gravel and fragments of rock.

This nearly level soil is along streams and in depressions in valleys underlain by limestone. Runoff is slow to very slow. Drainage is poor, and the soil is subject to occasional flooding.

Mapped with this soil are areas of a soil that is similar to the Melvin soils, but that developed on glacial till or locally transported materials. These areas are too small to be mapped separately.

Unless it is drained, Melvin silt loam is suited only to pasture or to plants that tolerate wetness. Most areas are in pasture. Mixtures of grasses and legumes that tolerate wetness are the best plants to grow.

Bedding and open ditches will provide surface drainage, and cattle can then graze the areas earlier in spring. Surface drainage will also improve the yields of pasture. If adequate outlets are available, tile drains can be installed to provide drainage so that the areas will be suitable for growing cultivated crops or hay. Nevertheless, flooding will still be a hazard.

This soil is in capability unit IIIw–2; woodland group 11; and group 13 for building sites.

Melvin silt loam, local alluvium, 0 to 3 percent slopes (MkA).—The profile of this soil is similar to the one described as typical for the series, but the surface layer consists of silt washed from higher areas. Also, the profile is generally more silty throughout.

This soil is in nearly level areas and in depressions where surface water collects. The permeability in the subsoil and underlying material is slow, but the soil is high in natural fertility.

If this soil is drained, it can be used for corn and small grains occasionally. Open drainage ditches are needed to provide drainage for cultivated crops and to get the best yields of hay and pasture. If it is not drained, the soil is suited only to pasture and hay. It is well suited to timothy, alsike clover, ladino clover, reed canarygrass, and redtop.

This soil is in capability unit IIIw–1; woodland group 11; and group 12 for building sites.

Melvin silt loam, local alluvium, 3 to 8 percent slopes (MkB).—The profile of this soil is similar to the one described as typical for the series, but mottling is at a greater depth. Less silt has accumulated on the surface than on the surface of Melvin silt loam, local alluvium, 0 to 3 percent slopes.

This soil has a slowly permeable subsoil and substratum. It is high in natural fertility.

This soil can be used occasionally for tilled crops, but it is better suited to pasture, hay, and trees unless it is drained. If cultivated, the soil is subject to erosion. Diversion terraces can be used on long slopes to intercept and remove excess water from higher areas.

This soil is in capability unit IIIw–1; woodland group 11; and group 12 for building sites.

Monongahela Series

The Monongahela series consists of deep, moderately well drained soils of stream terraces. These soils have a yellowish-brown subsoil that is distinctly mottled in the lower part. They generally have a slowly permeable layer, or fragipan, in the lower part of the subsoil that slows the downward movement of water. In places the fragipan also reduces root penetration.

The Monongahela soils developed in old alluvium in areas underlain by shale. They are in the northern part of the county in areas that are slightly higher than the adjacent flood plains.

These soils are near the moderately well drained Philo and poorly drained Atkins soils of the flood plains. They are also near the moderately well drained Comly, the shallow Montevallo, and the deep, well-drained Trexler soils of the uplands. In some places they are near soils of the Wheeling series.

Typical profile of Monongahela silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, smooth boundary; 8 to 11 inches thick.

B_{21} 10 to 18 inches, yellowish-brown (10YR 5/4) silty clay loam; weak, fine, blocky structure; friable when moist, sticky when wet; thin clay films; slightly acid; gradual, wavy boundary; 7 to 9 inches thick.

B_{22mg} 18 to 28 inches, light yellowish-brown (10YR 6/4) silty clay loam; a few, fine, faint mottles of yellowish brown (10YR 5/8); weak, fine, blocky structure; firm when moist, sticky and plastic when wet; medium clay films; slightly acid; gradual, wavy boundary; 8 to 11 inches thick.

B_{3mg} 28 to 38 inches, pale-brown (10YR 6/3) silty clay loam; a few, medium, distinct mottles of yellowish brown (10YR 5/8); weak, moderate, platy structure; firm when moist; strongly acid; gradual, wavy boundary; 8 to 11 inches thick.

C_{1mg} 38 inches +, pale-brown (10YR 6/3) sandy clay loam; many, coarse, distinct mottles of light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6); weak, coarse, prismatic or massive structure; firm when moist; strongly acid.

The texture of the profile ranges from shaly sandy loam to silty clay loam. The color of the mottles ranges from light yellowish brown to light brownish gray. Depth to the mottles ranges from 18 to 36 inches. Where the soil has not been heavily limed in recent years, the reaction in the upper part of the subsoil is medium acid or strongly acid instead of slightly acid.

These soils have moderately slow permeability in the subsoil and slow permeability in the substratum. Most areas are in crops, but some small areas are in pasture.

Monongahela silt loam, 0 to 3 percent slopes (MlA).—The profile of this soil is like the one described as typical for the series. In places, however, the surface layer is thicker than that in the profile described because local flooding has caused soil material to accumulate on the areas. Also, the profile contains rounded pebbles of sandstone and shale, and in places it is more sandy than the one described.

This soil is fair for the crops commonly grown in the county, and it is fair for pasture and trees. Growing grasses and legumes helps to improve the structure and to maintain the supply of organic matter. The soil needs surface drainage so that crops can be planted earlier, and surface drainage will improve yields. Diversions can be used to carry surface water away safely, and in places tile drains can be used. A suitable rotation includes at least 1 year of hay every 2 years. Lime and fertilizer are needed for best yields.

This soil is in capability unit IIw–1; woodland group 9; irrigation group 4; and group 10 for building sites.

Monongahela silt loam, 3 to 8 percent slopes, moderately eroded (MlB2).—The profile of this soil is similar to

the one described as typical for the series, but its surface layer is thinner and contains larger amounts of rounded gravel and fragments of stone. Depth to mottling is also greater. In some places material from the subsoil is mixed into the plow layer. In these places the present surface layer is lighter colored and contains more clay than that of the profile described.

This soil is fair for the general farm crops commonly grown in the county. If it is used for cultivated crops, however, it requires protection from further erosion. Graded stripcropping helps to conserve moisture and to control erosion. Diversion terraces can be used to remove excess surface water. Growing hay and grasses in long rotations will also help to control erosion and provide organic matter. A suitable rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Montalto Series

The Montalto series consists of deep, well-drained soils of uplands. The soils formed in material weathered from dark-gray, igneous rocks, generally from Triassic diabase. The diabase has intruded into the Triassic shale in places and has baked it so that its color is now blue, black, or dark purple instead of red. The soils in such areas are shallow over bedrock. They occur only in small areas and are generally mapped with the Penn soils.

The Montalto soils have a dark-brown surface layer. Their subsoil is yellowish red to red and is fine textured. There are many round boulders on the surface in many places. These were broken from the underlying diabase blocks as the result of weathering.

The Montalto soils are mainly in the southern part of the county. They are stony in areas where the stones have not been removed.

These soils are generally near the deep, well-drained Norton soils and the moderately deep to shallow, well-drained Penn soils. They are also near the moderately well drained to somewhat poorly drained Readington and the poorly drained Croton soils. In a few places they are near the Chester soils.

Typical profile of Montalto silt loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area:

A_p 0 to 10 inches, dark-brown (7.5YR 3/2) silt loam; weak, fine, granular structure; friable when moist, nonsticky when wet; medium acid; abrupt, smooth boundary; 7 to 11 inches thick.

B_{21} 10 to 16 inches, yellowish-red (5YR 5/6) silty clay loam; moderate, medium to coarse, subangular blocky structure; friable when moist, very sticky when wet; coatings of clay on the surfaces of peds; medium acid; gradual, wavy boundary; 5 to 7 inches thick.

B_{22} 16 to 49 inches, red (2.5YR 4/8) silty clay loam; strong, coarse, subangular blocky structure; firm when moist, very sticky and plastic when wet; medium acid; gradual, wavy boundary; black concretions of iron manganese in upper part; 24 to 40 inches thick.

B_3 49 to 60 inches, red (2.5YR 5/6) coarse clay loam; weak, moderate, platy structure; firm when moist; medium acid; gradual, wavy boundary; 6 to 12 inches thick.

C_1 60 inches +, red (2.5YR 5/6) and yellowish-red (5YR 5/8) gritty clay loam; weak, medium, platy structure; friable when moist; medium acid.

The color of the subsoil ranges from yellowish red to red. The texture is silty clay loam to clay loam.

These soils have moderately slow permeability in the subsoil and substratum. Their available moisture capacity and natural fertility are high.

The Montalto soils are excellent for orchards, pasture, and mixed hay crops. They are fair for general farm crops grown in rotation. In areas where the former subsoil is exposed, the soils are difficult to manage and good tilth is hard to maintain.

Montalto silt loam, 3 to 8 percent slopes, moderately eroded (MmB2).—The profile of this soil is like the one described as typical for the series. The soil is deep and fine textured, and its subsoil is red to yellowish red. From one-fourth to three-fourths of its original surface layer has been lost through erosion.

Mapped with this soil are areas of a soil that is nearly level and other areas of a soil that is gravelly. These included areas are too small to be mapped separately.

Montalto silt loam, 3 to 8 percent slopes, moderately eroded, is excellent for orchards, pasture, and mixed hay crops. It is fair for the general farm crops commonly grown in the county. If the soil is used for row crops, it is subject to serious erosion. Contour stripcropping can be used to help control erosion and to conserve moisture. Diversion terraces will remove the excess surface water.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 3 for building sites.

Montalto silt loam, 8 to 15 percent slopes, moderately eroded (MmC2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and bedrock is nearer the surface. There are also varying amounts of subsoil mixed into the surface layer.

Mapped with this soil are areas of a gravelly soil. These are too small to be mapped separately.

Montalto silt loam, 8 to 15 percent slopes, moderately eroded, is excellent for orchards, pasture, and mixed hay crops. It is fair for the general farm crops commonly grown in the county. If this soil is used for tilled crops, it is subject to serious erosion. Contour stripcropping helps to control erosion and to conserve moisture. Diversion terraces can be used to remove the excess surface water. Growing grasses and legumes in a long rotation will help to improve the structure of the soil and to maintain the supply of organic matter.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 3; and group 4 for building sites.

Montalto silt loam, 8 to 15 percent slopes, severely eroded (MmC3).—The profile of this soil is similar to the one described as typical for the series, but it has a thinner surface layer and bedrock is nearer the surface. Much material from the subsoil has been mixed into the present surface layer, which also contains many fragments of rock. In some places the former subsoil is exposed and there are gullies.

This soil is better suited to hay, pasture, and orchards than to tilled crops, but tilled crops can be grown occasionally just before reseeding the areas to hay crops. Reseeding of the hay crops should be done in contour strips to help prevent further erosion. Lime and fertilizer are needed for good yields.

This soil is in capability unit IVe–1; woodland group 6; irrigation group 3; and group 4 for building sites.

Montalto silt loam, 15 to 25 percent slopes, moderately eroded (MmD2).—The profile of this soil is similar to the profile described for the series, but the surface layer is thinner and bedrock is nearer the surface. There are also larger fragments of rock in the profile. In some places there are gullies.

Mapped with this soil are areas where soil material has accumulated near the bottoms of slopes as the result of downhill creep or erosion.

Montalto silt loam, 15 to 25 percent slopes, moderately eroded, is better suited to hay crops, pasture, and orchards than to tilled crops. Tilled crops can be grown occasionally when the hay crops need to be reseeded. Reseeding should be done in contour strips to prevent further erosion. Growing grasses and legumes in a long rotation helps to improve the structure of the soil and to maintain organic matter. Lime and fertilizer are required for best yields.

This soil is in capability unit IVe–1; woodland group 5; irrigation group 3; and group 4 for building sites.

Montalto silt loam, 15 to 25 percent slopes, severely eroded (MmD3).—The profile of this soil is like the one described as typical for the series, but the surface layer is thinner and bedrock is nearer the surface. Much material from the subsoil is mixed into the surface layer, and there are many fragments of rock in the profile. In some places the former subsoil is exposed and there are gullies.

Most of this soil is in pasture and orchards, to which it is well suited. Only small areas are idle. Placing mulch in the gullies and on galled spots helps to reduce erosion. Applying lime and fertilizer will increase the growth of pasture plants.

The soil is in capability unit VIe–1; woodland group 6; irrigation group 3; and group 4 for building sites.

Montalto silt loam, 25 to 35 percent slopes, severely eroded (MmE3).—The profile of this soil is like the one described as typical for the series, but the surface layer is much thinner and bedrock is much nearer the surface. Also, larger amounts of rock fragments are concentrated throughout the profile. In some places the former subsoil is exposed and there are gullies.

Mapped with this soil are areas near the bottom of slopes where soil material has accumulated as the result of downhill creep and erosion. These areas are too small to be mapped separately.

Montalto silt loam, 25 to 35 percent slopes, severely eroded, is probably best suited to trees. It is well suited to white pine, red oak, scarlet oak, and white oak. The soil is also well suited to Christmas trees, but it is generally too steep for mechanical planters to be used.

This soil is in capability unit VIIe–1; woodland group 8; irrigation group 3; and group 9 for building sites.

Montalto very stony loam, 0 to 8 percent slopes (MnB).—This soil has a profile similar to the one described as typical for the series, but it is very stony. In wooded areas there is a thin, black layer of organic matter on the surface. The subsoil is yellowish red and is more gritty than that in the typical profile described. In most places there are large, rounded boulders on the surface and much gravel throughout the profile.

If cleared, some areas of this soil could be used as pasture, but in most places the stones make it impractical to clear the areas for crops or pasture. All of the soil is wooded, and the trees have been cut over several times for lumber.

This soil is in capability unit VIs–1; woodland group 2; and group 3 for building sites.

Montalto very stony loam, 8 to 25 percent slopes (MnD).—The profile of this soil is like the profile described as typical for the series, but it is very stony. In wooded areas there is a thin, black layer of organic matter on the surface. This soil contains many large, rounded stones and boulders that scale or flake off as they weather. The subsoil is yellowish red, but it is much coarser textured and more gritty than that in the profile described. The soil is on rolling to steep ridges underlain by diabase.

This soil is too stony for crops, but it has a limited use for pasture if it is cleared. All of it is wooded, and the trees have been cut over several times for lumber.

This soil is in capability unit VIs–1; woodland group 5; and group 4 for building sites.

Montalto very stony loam, 25 to 35 percent slopes (MnE).—The profile of this soil is like the one described as typical for the series, but it is very stony. The surface layer contains large boulders and cobbles that range from 2 to 8 feet in diameter. In places the stones are so concentrated that there are only a few trees.

All of this soil is wooded; it is much too steep and stony for agriculture. The stands of trees are generally too thin to pay for cutting them.

This soil is in capability unit VIIs–1; woodland group 7; and group 9 for building sites.

Montevallo Series

The Montevallo series consists of well-drained soils that are shallow over shale. These soils have a dark grayish-brown channery surface layer. The subsoil is thin and is yellowish-brown channery silt loam. The slopes are dominantly moderate to steep. These soils developed in frost-churned material or in material weathered from dark-gray shale of the Martinsburg formation. They are in the north-central part of the county. Figure 7 shows a typical landscape of these soils.

The Montevallo soils are near the moderately deep and deep, well drained Trexler, the moderately well drained Comly, and the deep, poorly drained Shelmadine soils. They are also near the Laidig, Buchanan, and Andover soils, which are on the northern edge of areas of the Montevallo soils.

Typical profile of Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded:

A_p 0 to 9 inches, very dark grayish-brown (10YR 3/2) channery silt loam; 50 percent coarse fragments; weak, fine, granular structure; very friable when moist; slightly acid; abrupt, smooth boundary; 7 to 10 inches thick.

C_1 9 to 17 inches, yellowish-brown (10YR 5/4) very shaly silt loam; 80 percent coarse fragments; structure obscured by fragments of shale; very friable when moist, slightly sticky when wet; slightly acid; clear, wavy boundary; 7 to 9 inches thick.

C_2 17 to 35 inches +, dark yellowish-brown (10YR 4/4) silt between the pieces of shale; 95 percent coarse fragments; structureless; slightly acid; 15 to 31 inches thick.

The color of the subsoil ranges from yellowish brown to grayish brown. Depth to shale is 8 to 20 inches. The fragments of shale in the soils range from ¼ inch to 6 inches in length. The slopes range from nearly level to very steep.

Figure 7.—A field of strongly sloping to hilly Montevallo soils. Corn and oats are growing in the contour strips, and a hedge of multiflora rose is in the background.

These soils have moderately rapid permeability in the subsoil. Their available moisture capacity is low, and they are low in natural fertility.

Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded (MoB2).—The profile of this soil is similar to the one described for the series, but it contains fewer fragments of shale and they are smaller. In addition, the underlying shale is at a somewhat greater depth in this soil.

Mapped with this soil are small areas in which the surface layer is thinner than that in the profile described and larger fragments of shale are on the surface.

Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded, is fair for the farm crops commonly grown in the county. If it is used for tilled crops, it is subject to erosion. Contour stripcropping and diversion terraces can be used to help reduce erosion and to conserve moisture. Growing grasses and legumes periodically maintains the structure of the soil and adds organic matter. This soil requires lime and fertilizer for best yields. A rotation is needed in which hay crops are grown at least 2 years in every 4.

This soil is in capability unit IIIe–3; woodland group 12; irrigation group 7; and group 7 for building sites.

Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded (MoC2).—The profile of this soil is similar to the one described as typical for the series, but it contains finer fragments of shale, and the underlying shale is at a slightly greater depth. The subsoil contains more silt, but fewer fragments of shale.

Mapped with this soil are small areas near the lower edge of slopes where soil material has washed from higher areas and has accumulated on the surface. Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded, should be cropped only occasionally when hay is reseeded. It is not well suited to frequent cropping because it is subject to serious erosion. Contour stripcropping and diversion terraces are needed to prevent further erosion and to conserve moisture. Growing grasses and legumes will help to reduce erosion and add organic matter to the soil. This soil requires lime and fertilizer for good yields. Lack of moisture, however, generally limits yields.

This soil is in capability unit IVe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Montevallo channery silt loam, 8 to 15 percent slopes, severely eroded (MoC3).—The profile of this soil is like the profile described as typical for the series, but the surface layer is thinner, contains larger fragments of shale, and is coarser textured. The profile is also shallower over bedrock. In small areas ledges of shale are exposed.

This soil is generally droughty. If it is used for tilled crops, it is subject to further erosion. The soil is better suited to pasture and trees than to tilled crops, but a tilled crop can be grown occasionally when pastures need to be reseeded. The pasture should be reseeded in contour strips to protect the soil from further erosion. Diversion terraces can be used to control runoff.

This soil is in capability unit VIe–2; woodland group 14; irrigation group 7; and group 8 for building sites.

Montevallo channery silt loam, 15 to 25 percent slopes, moderately eroded (MoD2).—The profile of this soil is like the one described for the series. The surface layer and subsoil consist of very shaly silt loam. Approximately 50 percent of the profile consists of fragments of shale that are intermixed with silt. Approximately 80 percent of the lower part of the subsoil consists of fragments of shale.

This soil is suited to pasture and trees. If it is cultivated, it is subject to severe erosion. Tilled crops should be grown only when pastures need reseeding. The reseeding should be done in contour strips, and diversions used to protect the soil from further erosion.

This soil is in capability unit VIe–2; woodland group 13; irrigation group 7; group 8 for building sites.

Montevallo channery silt loam, 15 to 25 percent slopes, severely eroded (MoD3).—The profile of this soil is like the one described as typical for the series, but the surface layer is thinner and the profile is shallower over bedrock. Also, the surface layer contains more fragments of shale and the fragments are commonly larger. In places there are small areas where ledges of shale are exposed and there are small gullies.

This soil is better suited to pasture and trees than to tilled crops. Grasses and legumes that tolerate drought are the best pasture plants to grow.

The soil requires lime and fertilizer for the maximum growth of plants. The galled spots and soil material in the gullies should be fertilized, seeded, and mulched to prevent further erosion. Rotating the pastures helps to prevent overgrazing and erosion caused by trampling.

This soil is in capability unit VIIe–2; woodland group 14; irrigation group 7; and group 8 for building sites.

Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded (MoE2).—The profile of this soil is similar to the one described as typical for the series, but it is shallower over bedrock and contains more shale. Also, the subsoil contains less silt and clay.

Mapped with this soil are small areas where the surface layer is thicker than that in the profile decribed. This is because soil material has accumulated on the areas as the result of downhill creep and erosion from higher areas.

Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded, is probably best suited to trees. It is

too steep and the hazard of erosion is too severe for farming. Trees that will grow on a shallow, droughty soil are the best to plant.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Montevallo channery silt loam, 25 to 35 percent slopes, severely eroded (MoE3).—The profile of this soil is like the one described as typical for the series, but the surface layer is thinner and it contains larger fragments of channery shale mixed with a small amount of silt. In places there are small areas where ledges of shale are exposed.

The steep slope and severe hazard of erosion make this soil unsuitable for farming; the soil is better used for trees and as areas for wildlife. Trees that tolerate drought are the best to plant.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Montevallo channery silt loam, 35 to 60 percent slopes, moderately eroded (MoF2).—The profile of this soil is similar to the one described as typical for the series, but it has a thinner surface layer and the profile contains more large fragments of shale mixed with a little silt. The profile is also much shallower to bedrock.

The steep slope and serious hazard of erosion make this soil unsuitable for farming; the soil is better suited to trees and to use as areas for wildlife. Trees that tolerate drought are the best to plant.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Montevallo channery silt loam, 35 to 60 percent slopes, severely eroded (MoF3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and the profile contains larger amounts of fragments of shale mixed with a little silt. In places there are small areas where ledges of shale are exposed.

The steep slope and severe hazard of erosion make this soil unsuitable for farming; the soil is better suited to trees and to use for wildlife areas. Trees that tolerate drought are the best to plant.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Montevallo very rocky silt loam, 8 to 25 percent slopes (MsD).—The profile of this soil is similar to the one described as typical for the series, but it is stony and ledgy and is shallow over bedrock. The surface layer is also thinner.

This soil is too stony and ledgy to be used for farming. It is probably best suited to trees. Trees that favor dry sites are the best to plant.

This soil is in capability unit VIs–1; woodland group 13; and group 8 for building sites.

Montevallo very rocky silt loam, 25 to 65 percent slopes (MsF).—The profile of this soil resembles the one described as typical for the series, but it is stony and ledgy, and it is very shallow over bedrock.

This soil is too stony and ledgy for farming and is probably best suited to trees. Trees that favor dry sites are the best to plant.

This soil is in capability unit VIIs–1; woodland group 15; and group 9 for building sites.

Murrill Series

The Murrill series is made up of deep, productive soils that are well drained. The surface layer of these soils is gravelly loam that overlies finer textured soil material. The Murrill soils formed in colluvium over material weathered from limestone. The colluvium washed from soils that formed in material weathered from quartzite, sandstone, granite, or granitic gneiss. It was deposited on soils formed in material weathered from limestone. In some places the Murrill soils are stony. Nearly all of the stony areas are wooded.

The Murrill soils are on the lower slopes of South Mountain. They are near the deep, well-drained Washington and poorly drained Melvin soils. They are also near the very stony Fleetwood and very stony Chester soils.

Typical profile of Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded, in a cultivated area:

A_p 0 to 6 inches, dark reddish-brown (5YR 2/2) gravelly loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, wavy boundary; 5 to 7 inches thick.

B_{21} 6 to 12 inches, yellowish-red (5YR 5/8) gravelly fine silt loam; weak, medium, subangular blocky structure; friable when moist, sticky when wet; slightly acid; clear, wavy boundary; 5 to 8 inches thick.

B_{22} 12 to 19 inches, reddish-yellow (7.5YR 7/8) silty clay loam; weak, angular blocky structure; friable when moist, sticky when wet; slightly acid; gradual, wavy boundary; 6 to 9 inches thick.

B_{23} 19 to 60 inches, yellowish-brown (10YR 5/6) sandy clay loam; moderate, medium, platy structure; firm when moist, slightly sticky when wet; medium acid; gradual, wavy boundary; 35 to 60 inches thick.

IIB_{24} 60 inches +, yellowish-red (5YR 5/8) clay loam; strong, coarse, angular blocky structure; friable when moist, sticky when wet; slightly acid.

The color of the subsoil ranges from yellowish brown to yellowish red. The texture of the B horizon in the part of the solum formed in colluvium ranges from sandy loam to silty clay loam. Depth to the reddish, clayey lower part of the B horizon, which developed in material weathered from limestone, ranges from 20 to 60 inches.

The permeability of these soils is moderately rapid in the subsoil and moderate in the substratum. The available moisture capacity is high, and natural fertility is medium. The stones and boulders in the stony areas range from 6 inches to 4 feet in diameter.

Murrill gravelly loam, 3 to 8 percent slopes, moderately eroded (MuB2).—This soil has small amounts of material from the subsoil mixed into the plow layer. The profile is gravelly, and in some places there are a few glacial boulders in the subsoil. In most of the acreage, the upper part of the profile is coarse textured and gravelly and the lower part is finer textured.

This soil is excellent for orchards and pasture. It is fairly well suited to the farm crops commonly grown in the county. If the soil is used for tilled crops, it is subject to serious erosion if it is not protected. Contour stripcropping and diversion terraces can be used to help control erosion. Growing grasses and legumes periodically will help to improve the structure of the soil and to maintain the supply of organic matter. A suitable rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 2; and group 1 for building sites.

Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded (MuC2).—This soil has a profile like the one described as typical for the series. It has lost from one-fourth to three-fourths of its original surface layer through erosion. This soil is more gravelly than adjacent, less sloping soils. There are a few cobbles and boulders in the profile.

Mapped with this soil are small, wooded areas where material from higher slopes has accumulated. In those areas the surface layer is thicker than that in the profile described.

Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded, is excellent for orchards and pasture, but it is only fair for the general farm crops commonly grown in the county. The soil erodes severely if it is not protected. Contour stripcropping helps to control erosion and to conserve moisture, and diversion terraces can be used to remove the excess surface water. A suitable 4-year rotation includes at least 2 years of hay crops.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 2; and group 2 for building sites.

Murrill gravelly loam, 8 to 15 percent slopes, severely eroded (MuC3).—The profile of this soil is like the one described as typical for the series, but it has a thinner surface layer. The surface layer is also lighter colored because large amounts of material from the subsoil have been mixed into it by plowing. This soil has more gravel on the surface than Murrill gravelly loam, 8 to 15 percent slopes, moderately eroded, because the finer particles have been removed by erosion. In some places the subsoil is near the surface and there are a few gullies.

This soil is better suited to hay, pasture, and orchards than to tilled crops, but a tilled crop can be grown occasionally when hay is reseeded. Reseeding the hay in contour strips will help prevent more serious erosion. Diversion terraces are needed on the long slopes.

This soil is in capability unit IVe–1; woodland group 6; irrigation group 2; and group 2 for building sites.

Murrill very stony loam, 0 to 8 percent slopes (MvB).—The profile of this soil is like the one described as typical for the series, but it has stones and boulders throughout. It also has a thin, black layer of organic matter on the surface.

This soil has limited use for pasture, but it is suitable for trees. Most of the areas are too stony to be cleared for other kinds of agriculture. Except for areas that have been used for building developments, most of this soil is wooded.

This soil is in capability unit VIs–1; woodland group 2; and group 5 for building sites.

Murrill very stony loam, 8 to 25 percent slopes (MvD).—The profile of this soil is like the one described as typical for the series, but it is very stony and is coarser textured. The surface layer also contains stones and boulders. In wooded areas where the soil has not been disturbed, there is a thin, black layer of organic matter on the surface.

This soil is better suited to trees than to pasture or tilled crops, but it provides a limited amount of pasture if it is cleared. Most of the acreage is wooded, but some of it has been used for building developments. Generally, it is impractical to clear the areas for farming, because of the stones.

This soil is in capability unit VIs–1; woodland group 5; and group 6 for building sites.

Norton Series

The Norton series consists of deep, well-drained soils of uplands. The surface layer of these soils is dark reddish brown, and their subsoil is red to reddish brown. The lower part of the subsoil is very firm; it has the properties of a clayey fragipan. These soils developed in material weathered from red Triassic shale and sandstone of the New Brunswick formation. In some places the soils are gravelly and coarse textured.

These soils are on ridges in the extreme southern part of the county, along the line between Bucks and Lehigh Counties. They are near the moderately deep to shallow Penn, the moderately well drained to somewhat poorly drained Readington, and the poorly drained Croton soils. They are also near the Chester and Montalto soils, which are deep and well drained.

Typical profile of Norton silt loam, 15 to 25 percent slopes, moderately eroded, in a cultivated area:

A_p	0 to 5 inches, dark reddish-brown (5YR 3/2) silt loam; moderate, medium, granular structure; friable when moist; slightly acid; abrupt, smooth boundary; 5 to 9 inches thick.
B_1	5 to 15 inches, red (2.5YR 4/6) silt loam; moderate, medium, subangular blocky structure; firm when moist; strongly acid; gradual, wavy boundary; 8 to 10 inches thick.
B_{21}	15 to 26 inches, dark-red (2.5YR 3/6) fine silt loam; moderate, medium, blocky structure; firm when moist; strongly acid; gradual, wavy boundary; 9 to 13 inches thick.
B_{22m}	26 to 40 inches, reddish-brown (2.5YR 4/4) silty clay loam; 15 percent coarse fragments; moderate, medium, blocky structure; very firm when moist; very strongly acid; clear, wavy boundary; 8 to 14 inches thick.
C	40 inches +, reddish-brown (2.5YR 5/4) silty clay loam; 40 percent shale fragments that increase in number with increasing depth; moderate, medium, blocky structure; firm when moist; very strongly acid.

The texture of the surface layer ranges from gravelly silt loam to fine sandy loam, and that of the subsoil, from silt loam to silty clay loam. The subsoil is yellowish brown to red. These soils have moderate permeability in the subsoil and moderately slow permeability in the substratum. They have high moisture-holding capacity and are medium in natural fertility. The soils generally are suited to the crops commonly grown in the county.

Norton silt loam, 0 to 3 percent slopes (NtA).—The profile of this soil is like the one described as typical for the series, but the surface layer is thicker. The soil has retained nearly all of its original surface layer. In some places there are small areas in depressions where soil material, washed from adjacent slopes, has accumulated on the surface. In places there are small areas where the surface layer is thinner than that in the profile described.

Norton silt loam, 0 to 3 percent slopes, is suited to the farm crops commonly grown in the county, but, if it is used for row crops, it is subject to some erosion. Farming on the contour will help to control erosion and to conserve moisture. Growing legumes and grasses periodically will

improve the structure of the soil and will maintain organic matter. A suitable 4-year rotation consists of winter cover crops grown after row crops and green-manure crops plowed down after small grain.

This soil is in capability unit I–2; woodland group 1; irrigation group 1; and group 3 for building sites.

Norton silt loam, 3 to 8 percent slopes, moderately eroded (NtB2).—The profile of this soil is similar to the one described as typical for the series, but depth to parent material is greater.

Small areas are included where soil material has accumulated on the surface of the lower slopes as the result of erosion. In other small areas the surface layer on the upper part of the slopes is more severely eroded than that in most areas of this soil.

Norton silt loam, 3 to 8 percent slopes, moderately eroded, is well suited to the general farm crops grown in the county, but, if it is tilled, it is subject to serious erosion. Contour stripcropping can be used to help control erosion on this soil and to conserve moisture. Diversion terraces will remove the excess surface water. A suitable 4-year rotation of medium intensity includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 1; and group 3 for building sites.

Norton silt loam, 8 to 15 percent slopes, moderately eroded (NtC2).—This soil has lost from one-fourth to three-fourths of its original surface layer through erosion. The surface layer has had varying amounts of material from the subsoil mixed into it.

In small areas on the lower edge of slopes, silt has accumulated. There are also small areas near the top of slopes where the surface layer is severely eroded.

Norton silt loam, 8 to 15 percent slopes, moderately eroded, is good for the general farm crops grown in the county, but, if it is used for crops, it needs practices that will protect it from further erosion. Contour stripcropping helps to control erosion and to conserve moisture. Diversion terraces can be used to remove the excess surface water. Growing grasses and legumes in a long rotation also helps to control erosion. A suitable 4-year rotation includes at least 2 years of hay crops.

This soil is in capability unit IIIe–2; woodland group 4; irrigation group 1; and group 4 for building sites.

Norton silt loam, 15 to 25 percent slopes, moderately eroded (NtD2).—The profile of this soil is like the one described as typical for the series, but it contains more fragments of rock and there are occasional gullies.

In small areas the surface layer is more severely eroded. There are also small areas near the bottom of slopes where soil material has accumulated.

Norton silt loam, 15 to 25 percent slopes, moderately eroded, is better suited to hay and pasture than to tilled crops. If it is used for tilled crops, it is subject to serious erosion. A tilled crop can be grown, however, when hay needs to be reseeded. Contour stripcropping can be used to reduce erosion and to conserve moisture. Diversion terraces will remove the excess surface water and will help to control erosion. Lime and fertilizer are needed to maintain productive stands of grasses and legumes.

This soil is in capability unit IVe–2; woodland group 4; irrigation group 1; and group 4 for building sites.

Penn Series

The Penn series consists of moderately deep to shallow, well-drained soils of uplands. In most areas the surface layer of these soils is dark-brown silt loam. It is underlain by dark reddish-brown to weak-red fine silt loam to loam.

These soils formed in material weathered from red and reddish-brown shale, siltstone, and sandstone of Triassic age. They are in the southern part of the county. Their slope is nearly level to steep.

The Penn soils are near the deep, well drained Norton soils, the moderately well drained to somewhat poorly drained Readington soils, and the poorly drained Croton soils.

Typical profile of Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area:

- A_p 0 to 7 inches, dark-brown (7.5YR 3/2) shaly silt loam; weak, medium, subangular blocky structure; friable when moist, nonsticky when wet; strongly acid; clear, wavy lower boundary; 6 to 9 inches thick.
- B_2 7 to 19 inches, dark reddish-brown (5YR 3/4) silty clay loam; 15 percent shale fragments; moderate, medium, blocky structure; friable when moist, very sticky and plastic when wet; strongly acid; diffuse, wavy boundary; 11 to 13 inches thick.
- B_3 19 to 28 inches, dark reddish-brown (5YR 3/3) shaly silt loam; 45 percent shale fragments; weak, medium, subangular blocky structure; friable when moist, sticky and plastic when wet; strongly acid; gradual, wavy boundary; 8 to 10 inches thick.
- C_1 28 inches +, dark reddish-brown (5YR 3/3) very shaly and gravelly silt loam; about 75 percent coarse fragments; weak, medium, granular structure; friable when moist, sticky when wet; strongly acid; the shale fragments increase in number with increasing depth and grade to shale bedrock at a depth of less than 36 inches.

The texture of these soils ranges from loam to fine silt loam or silty clay loam. It varies as the result of differences in the parent material, as does the available moisture capacity and permeability. The finer textured soils formed in material weathered from shale, and they have moderate available moisture capacity. The coarser textured soils formed in material weathered from sandstone, and they have low available moisture capacity.

The Penn soils are low in natural fertility. They respond well to lime and fertilizer, but they lack the ability to store large amounts of plant nutrients. These soils are fairly well suited to the general farm crops grown in the county.

In places within areas of the Penn shaly silt loams, there are spots occupied by a lighter colored, channery soil formed on porcelanite. These areas are adjacent to the Montalto soils. They are east of Coopersburg and north of the Bucks County line.

Penn shaly silt loam, 3 to 8 percent slopes (PeB).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is darker brown and is slightly thicker. The subsoil is reddish brown to weak red. In some places the texture is coarser than that in the profile described and there is quartz gravel in the surface layer and subsoil. In most areas there are fragments of shale in the surface layer, but they are more numerous in the lower part of the subsoil.

This soil is suited to the general farm crops commonly grown in the county. Most of the acreage is wooded. If the soil is used for tilled crops, it is subject to erosion. Contour stripcropping and diversion terraces can be grown to help control erosion and to conserve moisture. Growing grasses and legumes periodically helps to improve the structure of the soil and to maintain the supply of organic matter. A suitable rotation includes 1 year each of a row crop and a small grain and at least 1 year of hay or other soil-building crops.

This soil is in capability unit IIe–3; woodland group 12; irrigation group 7; and group 7 for building sites.

Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded (PeB2).—The profile of this soil is like the one described as typical for the series. Varying amounts of shale and material from the subsoil are mixed into the present plow layer.

Included with this soil are some small areas where the former subsoil is exposed and there are many gullies. There are also areas where intrusions of diabase have changed the color of the soil to a pinkish gray, dark gray, or grayish brown. These areas are all too small to be mapped separately.

Penn shaly silt loam, 3 to 8 percent slopes, moderately eroded, is suited to the general field crops commonly grown in the county. Hilly areas that are cultivated are subject to erosion and require a protective cover. Contour stripcropping can be used to help reduce erosion and to conserve moisture. Diversion terraces will help to remove excess surface water. Growing grasses and legumes periodically maintains the structure of the soil and adds organic matter. Lime and fertilizer are needed for the best yields. A suitable rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–3; woodland group 12; irrigation group 7; and group 7 for building sites.

Penn shaly silt loam, 8 to 15 percent slopes, moderately eroded (PeC2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer contains larger amounts of shale. The fragments of shale are larger and more numerous in the subsoil than in the surface layer. Also, larger amounts of material from the subsoil have been mixed into the present plow layer. In some places this soil is wooded, and in those areas it is not eroded.

This soil is fair for the general farm crops commonly grown in the county. If it is used for tilled crops, it needs protection from erosion. Contour stripcropping can be used to help control erosion and to conserve moisture. Diversion terraces will help to remove the excess surface water. Growing legumes and grasses regularly helps maintain the structure of the soil and adds organic matter. A suitable rotation is one in which a hay crop is grown at least 2 years in 4.

This soil is in capability unit IIIe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Penn shaly silt loam, 8 to 15 percent slopes, severely eroded (PeC3).—The profile of this soil is similar to the one described for the series, but it has a much thinner surface layer and there are more fragments of shale and other rocks on the surface. In many places the subsoil is exposed and there are former gullies.

This soil is better suited to hay, pasture, and trees than to tilled crops, but a tilled crop can be grown occasionally when the hay crop needs to be reseeded. The hay should be reseeded in contour strips to protect the soil from further erosion. Diversion terraces can be used to control erosion by removing the excess surface water. Growing grasses and legumes in a long rotation improves the structure of the soil and helps to maintain organic matter. Lime and fertilizer are needed for the best growth of plants.

This soil is in capability unit IVe–3; woodland group 14; irrigation group 7; and group 8 for building sites.

Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded (PeD2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer contains more fragments of shale and other rock. Also, the parent material is nearer the surface.

Mapped with this soil are small areas near the base of the slope where soil material has accumulated as the result of downhill creep and erosion.

Penn shaly silt loam, 15 to 25 percent slopes, moderately eroded, is better suited to hay, pasture, and trees than to tilled crops, but a tilled crop can be grown occasionally when it is necessary to reseed hay. Contour stripcropping and diversion terraces can be used to help prevent erosion. Growing grasses and legumes in a long rotation helps to maintain organic matter and the structure of the soil.

This soil is in capability unit IVe–3; woodland group 13; irrigation group 7; and group 8 for building sites.

Penn shaly silt loam, 15 to 25 percent slopes, severely eroded (PeD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and bedrock is nearer the surface. There are also more fragments of shale and other rocks in the profile. In many places the subsoil is exposed and there are gullies.

This soil is better suited to pasture or trees than to tilled crops. The pastures should be divided into sections to provide for rotational grazing. Lime and fertilizer are needed to maintain the vigorous growth of plants.

This soil is in capability unit VIe–2; woodland group 14; irrigation group 7; and group 8 for building sites.

Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded (PeE2).—The profile of this soil is like the one described as typical for the series, but bedrock is nearer the surface. There are also many fragments of shale and other rocks in the profile. In some places there are wooded areas, and in those areas the soil is only slightly eroded.

Mapped with this soil are small areas near the base of the slope where soil material has accumulated. These areas are too small to be mapped separately.

Penn shaly silt loam, 25 to 40 percent slopes, moderately eroded, is better suited to pasture or trees than to tilled crops. If it is used for pastures, the soil requires protection from overgrazing. Dividing the pastures into sections and rotating them help to prevent overgrazing. Lime and fertilizer are needed to improve the growth of plants.

This soil is in capability unit VIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Penn shaly silt loam, 25 to 40 percent slopes, severely eroded (PeE3).—The profile of this soil is like the profile described for the series, but the surface layer is much thinner and bedrock is closer to the surface. There are also larger amounts of shale and fragments of other rocks

in the surface layer and subsoil. In many places the subsoil is exposed and there are gullies.

This soil is better suited to trees than to pasture or tilled crops. The galled spots and gullies need to be seeded, fertilized, and mulched to control further erosion. Trees that can grow on a shallow, droughty soil are the best to plant.

This soil is in capability unit VIIe–2; woodland group 15; irrigation group 7; and group 9 for building sites.

Philo Series

The Philo series consists of moderately well drained soils of flood plains. The soils have a dark-brown surface layer. Their subsoil is brownish yellow to light gray and is mottled with gray and strong brown. The horizons in the Philo soils are weakly expressed.

These soils consist of recent alluvium. The alluvium was washed from soils of uplands that developed in material weathered from shale and sandstone. The Philo soils are along streams in the area, and they are subject to occasional flooding. The floodwaters remain for only a short period.

The Philo soils are adjacent to the poorly drained Atkins soils of flood plains. They are also near the deep, well drained Trexler, the poorly drained Shelmadine, and the moderately well drained Comly soils of the uplands.

Typical profile of Philo silt loam in a cultivated area:

A_p 0 to 10 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable when moist, nonsticky when wet; medium acid; gradual, wavy boundary; 10 to 12 inches thick.

C_1 10 to 24 inches, brown (10YR 5/3) silt loam; weak, fine, granular structure; friable when moist, slightly sticky when wet; strongly acid; gradual, wavy boundary; 11 to 14 inches thick.

C_2 24 to 38 inches, light-gray (10YR 7/1) silt loam; common, fine, faint mottles of yellowish brown (10YR 5/8); weak, fine, granular structure; friable when moist, slightly sticky when wet; strongly acid; clear, wavy boundary; 9 to 14 inches thick.

D 38 inches +, light-gray (10YR 7/1) sandy clay loam; weak, fine, granular structure; friable when moist, sticky when wet; strongly acid.

The texture of the surface layer ranges from fine sandy loam to silt loam.

These soils have moderate permeability in the subsoil and substratum. Their available moisture capacity is high. Natural fertility is moderate.

Philo silt loam (Ph).—This is the only Philo soil mapped in the county. The profile is like the one described as typical for the series. The profile contains very fine fragments of shale and an occasional rounded, sandstone cobble. The surface layer is mostly silt, but it contains some fine sand. The lower part of the subsoil has brownish-yellow mottles.

Mapped with this soil are areas, too small to be mapped separately, in which drainage is poor and mottles occur in the upper part of the subsoil. Also included are small, sloping areas of a soil that is well drained.

Philo silt loam is excellent for corn, mixed hay crops, and pasture, but it is only fair for the other crops commonly grown in the county. In some places crops are damaged occasionally by floods and by the resulting high water table. Where feasible, tile can be installed to improve drainage. Grasses and legumes that tolerate moderate wetness should be used for hay. A suitable 3-year rotation includes at least 1 year of hay.

This soil is in capability unit IIw–2; woodland group 9; irrigation group 1; and group 13 for building sites.

Readington Series

The Readington series is made up of deep, moderately well drained to somewhat poorly drained soils that are gently rolling. The soils formed in material weathered from red to reddish-brown Triassic shale, siltstone, and fine-grained sandstone. They are on uplands in the extreme southern part of the county, and in places they are in low-lying areas.

The Readington soils formed in the same kind of parent material as the moderately deep to shallow, well-drained Penn, the deep, well-drained Norton, and the poorly drained Croton soils.

Typical profile of Readington silt loam, 3 to 8 percent slopes, in a cultivated area:

A_p 0 to 10 inches, dark-brown (7.5YR 4/2) silt loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, wavy boundary; 8 to 10 inches thick.

B_{21} 10 to 20 inches, brown (7.5YR 5/2) gravelly silt loam; moderate, medium, subangular blocky structure; friable when moist; clay films on the surfaces of peds; medium acid; gradual, wavy boundary; 8 to 12 inches thick.

B_{22gm} 20 to 30 inches, reddish-brown (5YR 5/4) gravelly silty clay loam; a few, fine, faint mottles of reddish gray (5YR 5/2); moderate, medium to coarse, blocky structure; firm when moist; coatings of iron and manganese on the surfaces of some peds; strongly acid; clear, wavy boundary; 7 to 10 inches thick.

B_{3gm} 30 to 40 inches, reddish-brown (5YR 4/3) gravelly silty clay loam; common, medium, distinct mottles of pinkish gray (5YR 6/2); moderate, medium to coarse, blocky structure; firm when moist; strongly acid; gradual, wavy boundary.

D_r 40 inches +, weak-red (10R 4/3), partly weathered siltstone and shale that has silt and clay between the pieces.

The subsoil is yellowish brown to weak red, and its texture ranges from silty clay loam to gravelly sandy clay loam. Depth to mottling ranges from 18 to 30 inches.

The permeability is moderately slow in the subsoil, and it is slow or very slow in the substratum of these soils. The soils have high available moisture capacity. They are medium in natural fertility.

These soils have a tight or weakly cemented layer in the subsoil that slows the downward movement of water. It also interferes in places with the development of plant roots and prevents the roots from penetrating deeply. The water table is high in spring. These soils are not well suited to alfalfa, winter grain, or other plants that do not tolerate wetness.

Readington silt loam, 0 to 3 percent slopes (RdA).—The profile of this soil is similar to the one described as typical for the series, but it contains less gravel, shale, and fragments of other rocks.

Mapped with this soil are small areas where soil material has accumlated in pockets and in depressions. In those areas the surface layer is much thicker than in the profile described. Also, depth to mottling is slightly greater.

Readington silt loam, 0 to 3 percent slopes, is well suited to corn, mixed hay crops, and pasture, but it is only fair for the other crops commonly grown in the county. If a winter grain is grown, it is likely to freeze out during a severe winter. This soil has a pan that impedes drainage in the lower part of the subsoil. It is generally wet in spring. Consequently, it is difficult to plow the areas early. Tile drains can be used in places to improve drainage, and bedding is desirable in some places. Graded strips and diversion terraces will help to remove the excess surface water. A suitable rotation includes hay at least one-third of the time.

This soil is in capability unit IIw–1; woodland group 9; irrigation group 4; and group 10 for building sites.

Readington silt loam, 3 to 8 percent slopes (RdB).—The profile of this soil is like the profile described as typical for the series. The soil has retained most of its original surface layer. In many places soil material, washed down from higher slopes, has accumulated on the surface. This soil has a cemented layer in the lower part of the subsoil that impedes drainage. The lower part of the subsoil is mottled. There are pebbles and fragments of rock throughout the profile.

This soil is well suited to corn, mixed hay crops, and pasture, but it is only fair for the other crops commonly grown in the county. Grasses and legumes that tolerate wetness should be used for hay and pasture. The soil is generally wet in spring. Therefore, it is difficult to plow the areas early. Small grain is damaged by excess subsurface water from seeps and springs.

Where feasible, tile drains can be used to remove subsurface water from this soil. Graded strips and diversions are needed to help remove excess surface water. A suitable rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Readington silt loam, 3 to 8 percent slopes, moderately eroded (RdB2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and the parent material is closer to the surface. In some places material from the subsoil is mixed into the present plow layer. There are mottles in the lower part of the subsoil.

This soil is suited to corn, mixed hay crops, and pasture, but it is only fair for the other crops commonly grown in the county. If a small grain is grown, it is likely to freeze out in winter. This soil is subject to erosion if it is used for tilled crops. Graded stripcropping will help reduce erosion and remove excess surface water safely. Tile drains can be used to remove excess subsurface water and to improve the areas for plants. Grasses and legumes that tolerate wetness can be grown for mixed hay and pasture. A suitable 3-year rotation includes at least 1 year of a hay crop.

This soil is in capability unit IIe–4; woodland group 9; irrigation group 4; and group 10 for building sites.

Readington silt loam, 8 to 15 percent slopes, moderately eroded (RdC2).—The profile of this soil is like the one described as typical for the series, but the surface layer is somewhat thinner and bedrock is nearer the surface. Fragments of rock are more numerous throughout the profile, and a larger amount of material from the subsoil is mixed into the present surface layer.

This soil is fairly well suited to corn, mixed hay crops, and pasture, but it is only fair for the other crops commonly grown in the county. If it is used for tilled crops, it is subject to severe erosion. Graded stripcropping can be used to help reduce erosion and to remove excess surface water. Tile drains will help to improve drainage through the soil. Grasses and legumes that tolerate wetness are the best to grow for hay and pasture. A suitable 4-year rotation includes at least 2 years of hay crops and no more than 1 year of a row crop.

This soil is in capability unit IIIe–4; woodland group 10; irrigation group 4; and group 11 for building sites.

Riverwash

This miscellaneous land type consists of areas adjacent to streams that are subject to periodic flooding. The deposits are too recent for soil profiles to have developed.

Riverwash (Rv).—Riverwash consists of alluvium made up of deposits of cobbles, gravel, and sand. The areas are adjacent to or in the channels of the larger streams. Most of this miscellaneous land type is on gravel bars, on low flood plains, and on islands within the channel of the Lehigh River. The areas are flooded frequently, and there is a high water table. The land type is not suited to agriculture. In some places it can be used for recreation or for some kinds of wildlife.

This soil is in capability unit VIIIs–1 and group 13 for building sites.

Ryder Series

The Ryder series consists of well-drained soils that are moderately deep to shallow over calcareous, shaly limestone. The surface layer of these soils is very dark brown to yellowish-brown silt loam. It is underlain by light yellowish-brown to strong-brown fine silt loam or silty clay loam that contains mica. This underlying soil material has a slippery feel.

These soils formed in material weathered from thin-bedded, very shaly limestone, locally called cement rock. They are nearly level to strongly sloping.

The Ryder soils are near the Duffield silt loams and the Duffield silt loam, low clay variants. They are also near the well drained Washington soils, the moderately well drained Bedford, and the deep, poorly drained Melvin soils. Nearby are the Bedford and Lawrence soils and the Montevallo soils.

Typical profile of a Ryder silt loam in a cultivated area:

- A_p 0 to 10 inches, very dark brown (10YR 2/2) silt loam; weak, fine, granular structure; friable when moist, nonsticky when wet; neutral; abrupt, smooth boundary; 7 to 10 inches thick.
- B_2 10 to 24 inches, light yellowish-brown (10YR 6/4) silty clay loam; moderate, medium to coarse, blocky structure that grades to thin platy in the lower part of the horizon; friable when moist, sticky and plastic when wet; thin clay films on the surfaces of peds; neutral; abrupt, wavy boundary; 9 to 15 inches thick.
- C_1 24 to 28 inches, gray (10YR 6/1) silt, clay, and weathered shaly limestone that is calcareous just above the point of contact with unweathered calcareous shale and limestone.
- D_r 28 inches +, grayish-brown (2.5Y 5/2) and very dark gray (N 3/0) calcareous shaly limestone.

The color of the subsoil ranges from yellowish brown to light olive brown. The solum ranges from 10 to 30 inches in thickness. In areas where the soil overlies pure limestone, the C horizon consists of a thin layer of gray material, but where the underlying material is shaly limestone, the C horizon is at least 1 foot thick.

The Ryder soils have slow to rapid runoff, moderate available moisture capacity, and moderate permeability. They are high in natural fertility and are slightly acid to neutral.

These soils are well suited to the general farm crops commonly grown in the county. About half of the acreage is used for field crops, and limestone quarries occupy much of the rest. Only a small acreage is in pasture and trees.

Ryder silt loam, 0 to 3 percent slopes (RyA).—The surface layer of this soil is like the one described as typical for the series, but shaly limestone is at a slightly greater depth. A few coarse fragments of quartzite are scattered through the profile. The soil is nearly level to level and has slow to very slow runoff.

Mapped with this soil are small areas in depressions where soil material from higher areas has accumulated on the surface. In these areas the surface layer is thicker than that in the profile described.

Ryder silt loam, 0 to 3 percent slopes, is excellent for the general farm crops commonly grown in the county. Growing grasses and legumes every few years in the cropping system will improve the structure of the soil, add organic matter, and help to control erosion. Contour tillage is needed on the larger areas where slopes are 2 percent or more.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 5; and group 5 for building sites.

Ryder silt loam, 3 to 8 percent slopes, moderately eroded (RyB2).—The profile of this soil is like the one described as typical for the series, but small amounts of light-colored material from the subsoil have been mixed with the original darker colored surface soil. The subsoil contains only a few fragments of limestone. This gently sloping soil is on the floors of broad valleys. It has slow to medium runoff.

This soil is excellent for the general farm crops grown in the area. Contour stripcropping, diversion terraces, and grassed waterways can be used to help control erosion and to conserve moisture. A suitable 3-year rotation includes at least 1 year of a hay crop.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 5; and group 5 for building sites.

Ryder silt loam, 8 to 15 percent slopes, moderately eroded (RyC2).—The profile of this soil is similar to the one described as typical for the series, but small amounts of material from the subsoil have been mixed into the surface layer. Also, the profile contains some fragments of rock.

Mapped with this soil are small areas in which the surface layer is slightly thicker than that of the profile described.

This soil is excellent for the general farm crops grown in the county, but it requires practices that help to control erosion. Contour stripcropping is needed to help protect the soil and to conserve moisture. Diversion terraces can be used to help dispose of excess surface water. Growing grasses and legumes for a long period helps to improve the structure of the soil, maintains the organic matter, and also helps to control erosion. A suitable 4-year rotation includes at least 2 years of hay.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 5; and group 6 for building sites.

Ryder silt loam, 8 to 15 percent slopes, severely eroded (RyC3).—The profile of this soil is like the one described as typical for the series, but its surface layer is thinner and has more material from the subsoil mixed into it. Fragments of rock are also more numerous in the profile. In some places the former subsoil is exposed and there are a few small gullies.

This soil is better suited to hay, pasture, and trees than to tilled crops. A tilled crop can be grown occasionally when the hay crop needs reseeding. When reseeding is done, use contour strips to help control erosion and to conserve moisture.

Diversion terraces can be used to remove excess surface water from this soil. Reseeding and mulching the gullies and galled spots will help to prevent further erosion. Growing grasses and legumes improves the structure of the soil and helps to maintain organic matter.

This soil is in capability unit IVe–1; woodland group 6; irrigation group 5; and group 6 for building sites.

Ryder silt loam, 15 to 25 percent slopes, severely eroded (RyD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is somewhat thinner and fragments of rock are more numerous throughout the profile. Also, a large amount of material from the subsoil is mixed into the plow layer. In small areas the subsoil is exposed and there are small gullies.

This soil is better suited to pasture and trees than to crops that require tillage. Rotating pastures will prevent overgrazing and thus help prevent further erosion. Applying fertilizer will improve the growth of plants. When the pastures are reseeded, use contour strips and diversion terraces on long slopes.

This soil is in capability unit VIe–1; woodland group 6; irrigation group 5; and group 6 for building sites.

Ryder silt loam, 25 to 35 percent slopes, severely eroded (RyE3).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thinner and bedrock is nearer the surface. Also, the plow layer contains more fragments of rock and has had more material from the subsoil mixed into it. In some places the former subsoil is exposed and there are small gullies.

This soil is better suited to trees than to pasture or tilled crops. Galled spots and gullies should be reseeded and mulched to prevent further erosion. White pine and Norway spruce are suitable trees.

This soil is in capability unit VIIe–1; woodland group 8; irrigation group 5; and group 9 for building sites.

Shelmadine Series

The Shelmadine series consists of poorly drained, shaly soils of uplands. The surface layer of these soils is generally very dark grayish brown. In most places the subsoil is pale brown and has many strong-brown and gray mottles. The soils developed on pre-Wisconsin glacial till and in materials moved from nearby areas underlain by gray shale and slate of the Martinsburg formation. They are nearly level to gently sloping.

The Shelmadine soils are in depressions and in other areas that lie below seep lines in the northern part of the county. They are near the deep, well drained Trexler soils and the deep, moderately well drained to somewhat poorly drained Comly soils. They are also near the shallow, well drained Montevallo soils and the poorly drained Andover soils.

Typical profile of Shelmadine silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, dark-gray (10YR 4/1) silt loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, smooth boundary; 8 to 14 inches thick.

B_{21g} 10 to 21 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct mottles of brownish yellow (10YR 6/6) and gray (10YR 6/1) moderate, medium to coarse, subangular blocky structure; friable when moist; moderately acid; diffuse, wavy boundary; 9 to 13 inches thick.

B_{22g} 21 to 32 inches, gray (10YR 6/1) silty clay loam; common coarse, prominent, mottles of reddish yellow (7.5YR 6/8) and pink (7.5YR 7/4); moderate, medium to coarse, subangular blocky structure; firm when moist; strongly acid; diffuse, wavy boundary; 9 to 13 inches thick.

B_{3g} 32 to 34 inches, light-gray (N 7/0) silty clay loam; common, fine, prominent mottles of reddish yellow (7.5YR 7/6) and brownish yellow (10YR 6/8); moderate, coarse, angular blocky structure; firm when moist; strongly acid; gradual, wavy boundary; 2 to 12 inches thick.

C 34 inches +, gray (N 6/0) shaly silt loam; 80 percent shale fragments; structureless; strongly acid.

The color of the subsoil ranges from light brownish gray to gray. From 10 to 50 percent of the subsoil is mottled below a depth of 8 to 12 inches. These soils have slow permeability in the subsoil and very slow permeability in the substratum. The available moisture capacity is moderate, and natural fertility is low.

These soils are suitable for pasture and trees. They are also suitable for wildlife areas.

Shelmadine silt loam, 0 to 3 percent slopes (ShA).—The profile of this soil is like the one described as typical for the series. The soil is poorly drained and is strongly mottled or gleyed in the subsurface layer and subsoil. It has a claypan in the subsoil. There are small fragments of shale and occasional fragments of other rocks in the profile.

Mapped with this soil are small areas where soil material from higher areas has accumulated on the surface.

Shelmadine silt loam, 0 to 3 percent slopes, is better suited to hay or pasture than to tilled crops. The subsoil has a claypan that restricts the downward movement of water. As a result, the water table is high; it causes plants to drown out in some places. In winter, plants are killed as the result of heaving. Mixtures of grasses that tolerate wetness are the best to plant.

Open ditches and bedding can be used to improve drainage by removing the excess surface water and lowering the water table. Tile drains can be used to drain wet spots in places where adequate outlets are available.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for building sites.

Shelmadine silt loam, 3 to 8 percent slopes (ShB).—This gently sloping, poorly drained soil has mottles in the upper part of the subsoil. The surface layer contains fine fragments of shale and some fragments of other rocks. A claypan in the subsoil impedes downward drainage. The resulting high water table restricts the growth of plants.

Mapped with this soil are small areas where soil material from higher areas has accumulated on the surface. In these areas the surface layer is thicker than that in the profile described for the series.

Unless it is drained, Shelmadine silt loam, 3 to 8 percent slopes, is not suited to frequent use for cultivated crops. Most of the time this soil has excess water throughout the profile. The soil is suited to hay or pasture, but mixtures of grasses that tolerate wetness should be seeded. Yields can be improved by installing drains to lower the water table.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for building sites.

Shelmadine silt loam, 3 to 8 percent slopes, moderately eroded (ShB2).—The profile of this soil is similar to the one described as typical for the series. The surface layer is somewhat thinner, however, and it contains more fragments of shale and some material from the subsoil. Depth to mottling is also slightly greater, but the parent material is a little nearer the surface.

This soil is better suited to hay, pasture, and trees than to crops that require tillage. The excess water in the subsoil causes most crops to drown out. Grasses that tolerate wetness are the best to seed for pasture. The soil needs fertilizer and lime. Surface drains are required to remove excess water from the profile and to improve yields. Tile can be used to drain seep spots.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for building sites.

Shelmadine silt loam, 8 to 15 percent slopes, moderately eroded (ShC2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner. The surface layer also contains coarser fragments of shale, more fragments of other rocks, and some material from the subsoil. In addition, depth to mottling is slightly greater. The claypan is an obstacle to the penetration of plant roots and the percolation of water.

This soil is better suited to hay, pasture, and trees than to tilled crops. The claypan in the subsoil prevents plant roots from penetrating and retards the movement of water through the profile. Grasses that tolerate wetness are the best to seed for pasture. The soil needs lime and fertilizer. Surface drainage will improve yields. Tile can be used in seep spots to improve drainage.

This soil is in capability unit IVw–1; woodland group 11; irrigation group 6; and group 12 for building sites.

Trexler Series

The Trexler series consists of well-drained soils that are moderately shallow to deep over glacial till or over material weathered from shale or sandstone. The surface layer of these soils is dark brown. The subsoil is yellowish-brown to strong-brown silt loam, and it contains varying amounts of shale fragments. In some places the profile contains fragments of sandstone. The slope ranges from level to steep.

In places these soils developed on glacial till, and, in other places, on frost-churned material weathered from dark-gray to black shale and brown sandstone of the Martinsburg formation. The moderately shallow Trex-

ler soils generally are steep and their profile is more shaly or coarse textured than that of the deep Trexler soils. The coarse fragments in the profile consist of thin, easily split pieces of slate and shale that range from ½ to ¾ inch in diameter. The shale from which the Trexler soils formed weathers to yellowish brown or olive; generally, the soils that contain slate are darker colored than the soils that are not slaty.

The Trexler soils are in the northern part of the county. They are near the shallow, well drained Montevallo, the moderately well drained Comly, and the poorly drained Shelmadine soils.

Typical profile of Trexler shaly silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, dark-brown (10YR 4/3) silt loam; 20 percent fine shale fragments; weak, fine, granular structure; friable when moist; medium acid; abrupt, smooth boundary; 9 to 11 inches thick.

B_1 10 to 16 inches, yellowish-brown (10YR 5/6) fine silt loam; 15 percent shale fragments; moderate, fine, subangular blocky structure; moderate, thick clay films; friable when moist, plastic when wet; slightly acid; gradual, wavy lower boundary; 4 to 8 inches thick.

B_{21} 16 to 22 inches, yellowish-brown (10YR 5/6) fine silt loam; 15 percent shale fragments; very weak, medium, prismatic structure that breaks to weak, medium, subangular blocky; moderate, thick clay films; friable when moist, slightly sticky and slightly plastic when wet; slightly acid; gradual, wavy boundary; 4 to 8 inches thick.

B_{22} 22 to 29 inches, yellowish-brown (10YR 5/8) fine silt loam; 40 percent shale fragments; weak, medium, prismatic structure that breaks to moderate, subangular blocky; partial clay films and coatings of black iron and manganese on the surfaces of peds; firm in place when moist, slightly plastic and sticky when wet; strongly acid; clear, irregular boundary; 5 to 9 inches thick.

B_3 29 to 41 inches, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/8) fine silt loam; 40 percent yellowish-brown (10YR 5/8) shale fragments; moderate, fine, subangular blocky structure modified by shale fragments; partial clay films and many coatings of iron and manganese; firm in place when moist, friable when disturbed, and slightly sticky when wet; very strongly acid; clear, wavy boundary; 8 to 16 inches thick.

C_1 41 to 50 inches +, yellowish-red (5YR 5/6) and red (2.5YR 4/6) fine silt loam; cut surface shows 55 percent yellow (10YR 7/6) shale fragments; moderate, medium, platy structure modified by shale; many black coatings of iron and manganese; very firm in place when moist, slightly sticky when wet; very strongly acid.

The texture of the surface layer ranges from shaly silt loam to silt loam. The color of the subsoil ranges from yellowish brown to reddish yellow. In places the B horizon contains cobbles of red and gray sandstone and quartzite.

These soils are moderately permeable, and they have high to moderate available moisture capacity. Fertility is moderate, and the soils are moderately acid. The soils are easy to work, but the hazard of erosion is moderate. In places the shaly and shallow soils are droughty.

In most places these soils are used intensively for cultivated crops. Only small areas are used for pasture or as woodland.

Trexler shaly silt loam, 0 to 3 percent slopes (TrA).—The profile of this soil is like the one described as typical for the series. The soil is on broad, nearly level ridges, and it has slow to very slow runoff.

This soil is well suited to the general farm crops commonly grown in the county, and most of it is used for cultivated crops. Where the slope is more than 2 percent, farming ought to be on the contour. A cropping sequence in which grasses and legumes are grown every few years will help to maintain the structure and the content of organic matter.

This soil is in capability unit I–2; woodland group 1; irrigation group 1; and group 3 for building sites.

Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded (TrB2).—The profile of this soil is like the one described as typical for the series, but from one-fourth to three-fourths of the original surface layer has been lost through erosion. The present surface layer contains small chips of shale, and in places material from the subsoil is mixed into the plow layer. In most places the subsoil is yellowish brown, but in some areas it has a reddish color. The subsoil contains very few fragments of shale. Runoff is slow to medium.

Near Kempton, toward the Berks County line, areas of a deep, shaly soil are mapped with this soil. These areas are too small to be mapped separately.

The general farm crops commonly grown in the county grow well on Trexler shaly silt loam, 3 to 8 percent slopes, moderately eroded. Contour stripcropping and diversion terraces are needed to help control erosion and to conserve moisture. Growing grasses and legumes periodically will help to maintain the structure and to increase the content of organic matter. A suitable rotation of medium intensity includes at least 1 year of hay following a row crop and small grain.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 1; and group 3 for building sites.

Trexler shaly silt loam, 3 to 8 percent slopes, severely eroded (TrB3).—The profile of this soil is like the profile described as typical for the series, but the surface layer is slightly thinner and the subsoil contains more fragments of shale and sandstone. In some places on sharp knolls and on small ridges, the former subsoil is exposed. In other places the surface layer is lighter colored than that in the profile described because large amounts of material from the subsoil have been mixed into it.

This soil is fairly well suited to the general farm crops commonly grown in the county. Growing grasses and legumes in long rotations and using contour stripcropping and diversion terraces will help to control erosion and to conserve moisture. A suitable 4-year rotation includes at least 2 years of hay crops.

This soil is in capability unit IIIe–2; woodland group 3; irrigation group 1; and group 3 for building sites.

Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded (TrC2).—The surface layer of this soil is slightly thinner than that in the profile described as typical for the series, and it contains more fragments of shale and sandstone. Also, a larger amount of material from the subsoil has been mixed into the plow layer. Runoff is medium to rapid.

Mapped with this soil are areas of a deep, shaly soil. These areas are near Kempton, towards the Berks County line, and are too small to be mapped separately.

Trexler shaly silt loam, 8 to 15 percent slopes, moderately eroded, is fairly well suited to the general farm crops grown in the county, but it is susceptible to erosion.

It generally requires contour stripcropping and diversion terraces to control erosion and to conserve moisture. A suitable 4-year rotation includes at least 2 years of hay crops.

This soil is in capability unit IIIe–2; woodland group 4; irrigation group 1; and group 4 for building sites.

Trexler shaly silt loam, 8 to 15 percent slopes, severely eroded (TrC3).—The profile of this soil is similar to the one described as typical for the series. The surface layer is thinner, however, the plow layer is lighter colored and contains more material from the subsoil, and fragments of shale and sandstone are more numerous throughout. In some places on small, narrow ridges the former subsoil is exposed. Gullies and rills are common on the long slopes.

This soil is better suited to hay than to crops that require tillage. It needs to be kept in long rotations that include grasses and legumes. When reseeding, contour strips and diversion terraces ought to be used to help control erosion.

This soil is in capability unit IVe–3; woodland group 6; irrigation group 1; and group 4 for building sites.

Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded (TrD2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thinner and it contains more shale. Also, more material from the subsoil is mixed into the plow layer.

Mapped with this soil are small areas near the lower ends of slopes where soil material has accumulated on the surface as the result of downhill creep or erosion. These areas are all too small to be mapped separately. In places near Kempton toward the Berks County line, areas of a deep, shaly soil are included.

Trexler shaly silt loam, 15 to 25 percent slopes, moderately eroded, is better suited to hay, pasture, and trees than to crops that require tillage. A tilled crop can be grown occasionally when hay is to be reseeded. If this soil is used for tilled crops, it is subject to severe erosion. When hay needs to be reseeded, contour strips ought to be used to help control erosion and to conserve moisture. Diversion terraces can be used to remove excess water.

This soil is in capability unit IVe–3; woodland group 4; irrigation group 1; and group 4 for building sites.

Trexler shaly silt loam, 15 to 25 percent slopes, severely eroded (TrD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and bedrock is nearer the surface. Also, the plow layer generally contains larger amounts of shale, and much material from the subsoil has been mixed into it.

This steep, eroded soil is better suited to pasture or trees than to tilled crops. It requires a cover of perennial vegetation. When the areas need to be reseeded, contour strips ought to be used to help control erosion and to conserve moisture.

This soil is in capability unit VIe–1; woodland group 6; irrigation group 1; and group 4 for building sites.

Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded (TsA2).—The profile of this soil is similar to the one described as typical for the series, but it contains coarser and more numerous fragments of shale, and hard shale is nearer the surface. Some material from the subsoil has been mixed into the plow layer. This nearly level soil is on ridgetops and has slow to medium runoff. If the areas on long slopes are cultivated, the soil is likely to be seriously eroded.

In places this soil is wooded and is not eroded. There are also some areas that resemble pockets where soil material has accumulated on the surface.

Trexler shaly silt loam, moderately shallow, 0 to 3 percent slopes, moderately eroded, is fair for the general farm crops grown in the county. Potatoes and corn are the main crops.

Growing grasses and legumes periodically helps to improve the structure of this soil and to maintain the content of organic matter. Farming the areas on the contour will help to control erosion and to conserve moisture. For best yields, the soil requires fertilizer and lime.

This soil is in capability unit IIe–3; woodland group 12; irrigation group 5; and group 5 for building sites.

Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded (TsB2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer contains more fragments of shale and sandstone, and hard rock is nearer the surface. Also, some material from the subsoil is mixed into the plow layer. This gently sloping soil is on ridgetops, and it has slow to medium runoff. If large areas of it are cultivated, sheet and gully erosion are likely to cause serious damage.

In some places this soil contains sandstone gravel. In other places it contains large amounts of slaty material. Some areas are wooded and are little eroded.

Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, moderately eroded, is only fair for the crops commonly grown in the county, and it is also fair for orchards and woodland. Nevertheless, most of the acreage is used for crops. Contour strips and diversion terraces are needed to help reduce erosion and to conserve moisture. Lime, commercial fertilizer, and manure are required for best crop yields.

This soil is in capability unit IIe–3; woodland group 12; irrigation group 5; and group 5 for building sites.

Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded (TsB3).—The profile of this soil is like the one described as typical for the series, but the surface layer contains larger amounts of shale and fragments of sandstone. The fragments are also larger, and hard rock is nearer the surface. Material from the subsoil has been mixed into the plow layer.

In some places the former subsoil is exposed and there are numerous small rills and gullies. In places this soil is gravelly and sandy. In some places the soil material has weathered from grayish-brown, fine-grained sandstone, and the soil has platy structure and is mixed with shale. In other places the soil contains slaty material.

Trexler shaly silt loam, moderately shallow, 3 to 8 percent slopes, severely eroded, is fair for the farm crops commonly grown in the county. Crops grown on it require irrigation during dry spells in summer. Growing grasses and legumes at least half of the time will improve the structure of the soil and help maintain organic matter. Contour strips can be used to reduce runoff and to conserve moisture. Diversion terraces will help to remove excess surface water and to prevent further erosion.

This soil is in capability unit IIIe–3; woodland group 12; irrigation group 5; and group 5 for building sites.

Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded (TsC2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer contains varying amounts of shale and sandstone fragments. Also, hard bedrock is nearer the surface. In cultivated areas the present surface layer has varying amounts of material from the subsoil mixed into it. This moderately sloping soil is on the sides of ridges and has medium to rapid runoff.

In some wooded areas this soil is but little eroded. There are also small areas where soil material from higher areas has accumulated on the surface.

Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, moderately eroded, is fair for the crops commonly grown in the county. It is subject to serious erosion, however, if it is cultivated and is not protected. The soil is somewhat droughty during dry seasons, and irrigation is needed if plants are to grow well. Contour stripcropping can be used to prevent further erosion and to conserve moisture. Diversion terraces will help remove the excess surface water.

This soil is in capability unit IIIe–3; woodland group 13; irrigation group 5; and group 6 for building sites.

Trexler shaly silt loam, moderately shallow, 8 to 15 percent slopes, severely eroded (TsC3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner. Also, more fragments of shale and sandstone are on the surface and throughout the profile. In cultivated areas the former subsoil is exposed and there are small rills and gullies. The soil is moderately sloping and is on uplands. It has medium to rapid runoff.

This soil is probably best suited to hay crops, but tilled crops can be grown occasionally when hayfields need to be reseeded. Irrigation is required during dry seasons if plants are to grow well.

Growing grasses and legumes for long periods improves the structure of the soil and helps build up the content of organic matter. When hayfields need to be reseeded, use contour strips to help control erosion and to conserve moisture. Lime and fertilizer are needed to maintain good yields and to establish a stand of hay that includes alfalfa.

This soil is in capability unit IVe–3; woodland group 14; irrigation group 5; and group 6 for building sites.

Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded (TsD2).—The profile of this soil is similar to the one described as typical for the series, but it contains larger fragments of shale and other rocks and hard bedrock is nearer the surface. In areas that have been cultivated, the present surface layer has much material from the subsoil mixed into it. This soil has strong slopes and is on the sides of ridges. It has rapid to very rapid runoff.

In places there are small areas where this soil is wooded and is but little eroded. In some places the soil contains sand and gravel.

Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, moderately eroded, is better suited to hay than to tilled crops, but a tilled crop can be grown occasionally when a hay crop needs to be reseeded. When the hay crop is reseeded, contour strips are required to control runoff, prevent further erosion, and conserve moisture. Lime and fertilizer are needed to establish the hay crop and to keep it growing well. Irrigation will be required during dry spells.

This soil is in capability unit IVe–3; woodland group 13; irrigation group 5; and group 6 for building sites.

Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded (TsD3).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and contains more fragments of shale and other rock. Hard bedrock is also nearer the surface. The former subsoil is exposed in some areas that have been cultivated, and there are small gullies. This strongly sloping soil is on the sides of narrow ridges. It has rapid to very rapid runoff.

Mapped with this soil are areas of a soil that contains large fragments of shale and that is even shallower over bedrock. In some places near Kempton, toward the Berks County line, areas of a deep, shaly soil are also included. The included areas are all too small to be mapped separately.

Trexler shaly silt loam, moderately shallow, 15 to 25 percent slopes, severely eroded, is better suited to pasture or trees than to tilled crops. Plants that tolerate drought should be seeded in the pastures.

When the pastures require reseeding, contour strips ought to be used to help prevent erosion. Lime and fertilizer are needed to establish the stand and to maintain good growth of the pasture plants. The pastures can be divided and the sections rotated to prevent overgrazing. In this way, erosion can be controlled and yields increased.

This soil is in capability unit VIe–2; woodland group 14; irrigation group 5; and group 6 for building sites.

Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded (TsE2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thinner. The surface layer and subsoil also contain more fragments of shale and other rocks, and bedrock is nearer the surface. This steep soil is on the sides of narrow ridges and on the walls of valleys.

In places this soil contains slate or gravel. There are also wooded areas where the soil is only slightly eroded.

Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, moderately eroded, is better suited to pasture than to tilled crops. Mixtures of grasses that tolerate drought are the best to seed in the pastures. Lime and fertilizer are needed to maintain good growth of the pasture plants. The pastures should be divided and the sections rotated to prevent overgrazing and to help control erosion.

This soil is in capability unit VIe–2; woodland group 15; irrigation group 5; and group 9 for building sites.

Trexler shaly silt loam, moderately shallow, 25 to 35 percent slopes, severely eroded (TsE3).—This steep soil is on the sides of narrow ridges and on the walls of valleys. Its profile is similar to the one described as typical for the series, but the surface layer is thinner. Also, fragments of shale that are 3 to 4 inches in diameter are on the surface, and bedrock is nearer the surface. The subsoil contains varying amounts of shale. Gullies and rills are common in areas of this soil.

The steep slope makes modern farm machinery impractical to use on this soil. Pastures are difficult to maintain because the soil is droughty. Much of this soil should be planted to pines.

The soil is in capability unit VIIe–2; woodland group 15; irrigation group 5; and group 9 for building sites.

Washington Series

The Washington series consists of deep soils that are well drained. These soils have a dark-brown, silty surface layer. Their subsoil is strong-brown, yellowish-red, and brown silty clay loam. The underlying material, mainly a yellowish-brown silt loam or silty clay loam, is glacial till or frost-churned material weathered from limestone.

These soils are in a belt that is 4 miles wide and lies across the central part of the county. They are level to strongly sloping. The native vegetation was oak, maple, walnut, hickory, chestnut, and yellow-poplar.

The Washington soils are near the moderately well drained Bedford soils and the poorly drained local alluvium phases of the Melvin silt loams. They are also near the Ryder soils and the shallower Duffield soils.

Some soils similar to the Washington soils, but that contain more gravel or sand and less clay, have been included in the Washington series. These are mapped as coarse variants of the Washington gravelly loams. The variants developed in gravelly material from terminal moraines. They are similar to the Washington soils, but they have more gravel throughout the profile and more sand and less clay in the B and C horizons.

Typical profile of Washington silt loam, 3 to 8 percent slopes, in a cultivated area:

- A_p 0 to 9 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable when moist; slightly acid; abrupt, smooth boundary; 8 to 10 inches thick.
- A_3 9 to 12 inches, yellowish-brown (10YR 5/4) silt loam; weak, medium, subangular blocky and weak, medium, platy structure; partial clay films on peds; friable when moist, slightly plastic when wet; slightly acid; clear, wavy boundary; 1 to 5 inches thick.
- B_1 12 to 16 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; moderate, thick clay films on the surfaces of peds; friable when moist, sticky and plastic when wet; many medium pores; slightly acid; gradual, wavy boundary; 2 to 6 inches thick.
- B_{21} 16 to 21 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium and fine, subangular blocky structure; thick clay films on the surfaces of peds; friable when moist, sticky and plastic when wet; slightly acid; gradual, wavy boundary; 3 to 7 inches thick.
- B_{22} 21 to 29 inches, strong-brown (7.5YR 5/6) silty clay; moderate, medium, subangular blocky structure; thick clay films and a few coatings of black iron and manganese on the surfaces of peds; firm when moist, sticky and plastic when wet; neutral; gradual, wavy boundary; 6 to 10 inches thick.
- B_{23} 29 to 33 inches, strong-brown (7.5YR 5/8) silty clay; a few, reddish-yellow shale fragments; moderate, medium, blocky structure; thick clay films and many black coatings of iron and manganese on the surfaces of peds; firm when moist, sticky and plastic when wet; slightly acid; clear, wavy boundary; 2 to 6 inches thick.
- B_{31} 33 to 40 inches, yellowish-red (5YR 5/6) silty clay loam; weak, fine, blocky and weak, medium, platy structure; partial clay films and many coatings of iron and manganese on the surfaces of peds; firm to friable when moist, sticky and plastic when wet; medium acid; clear, wavy boundary; 5 to 9 inches thick.
- B_{32} 40 to 43 inches, yellowish-red (5YR 5/8) fine silt loam; many yellowish shale chips; weak, fine, blocky and weak, medium, platy structure; partial clay films and a few coatings of iron and manganese on the surfaces of peds; friable when moist, slightly sticky and slightly plastic when wet; strongly acid; abrupt, irregular boundary, 1 to 7 inches thick.
- D_r 43 inches +, light olive-brown (2.5YR 5/4), weathered shale and shaly limestone fragments; strongly acid.

The surface layer of these soils is generally very dark grayish brown to yellowish brown, but in places it is reddish brown or dark brown. Depth to bedrock ranges from 3 to 15 feet.

These soils are moderately fertile. They have moderately rapid permeability and high available moisture capacity.

Most areas of the Washington soils are used for cultivated crops, but small areas are in pasture. Only a few areas are still wooded.

Washington silt loam, 0 to 3 percent slopes (WgA).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thicker. In most areas the soil is but little eroded, and nearly all of the original surface soil remains. There are cobbles and boulders of quartzite scattered sparsely over the surface and through the profile. The subsoil contains many black iron and manganese coatings and concretions.

This soil is excellent for the general farm crops commonly grown in the county. Growing grasses and legumes periodically will help maintain the structure of the soil and the content of organic matter. Corn and small grain can be grown frequently if cover crops and green-manure crops are planted frequently.

This soil is in capability unit I–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Washington silt loam, 0 to 3 percent slopes, moderately eroded (WgA2).—Material from the subsoil has been mixed into the plow layer of this soil in some places. Cobbles and boulders of quartzite are scattered sparsely over the surface and through the profile. The subsoil contains some black iron and manganese coatings and concretions. The soil erodes somewhat easily.

This soil is excellent for the general farm crops commonly grown in the county. Growing grasses and legumes periodically helps to maintain the structure of the soil and the content of organic matter. On slopes of more than 2 percent, farming on the contour would help prevent further erosion. In some places the soil needs protection from runoff water that comes from higher areas. A suitable 5-year rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Washington silt loam, 3 to 8 percent slopes (WgB).—The profile of this soil is like the one described as typical for the series. The soil has been but little eroded in most places and has retained nearly all of its original surface layer. Boulders and gravel are scattered throughout the profile.

This soil is excellent for the general farm crops commonly grown in the county, but it is subject to erosion if it is used for tilled crops. Growing grasses and legumes periodically helps to improve the structure of the soil and to maintain the supply of organic matter. Contour stripcropping and diversion terraces can be used to help prevent erosion and to conserve moisture. A suitable rotation includes at least 1 year of hay every 3 years.

Figure 8.—Large fields of cultivated crops are typical on Washington silt loam, 3 to 8 percent slopes, moderately eroded; the rounded and angular cobbles in the foreground are quartzite.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Washington silt loam, 3 to 8 percent slopes, moderately eroded (WgB2).—The profile of this soil is similar to the one described as typical for the series. Material from the subsoil has been mixed into the plow layer in some places. There are a few cobbles and pebbles on the surface and in the profile. The subsoil contains black iron and manganese coatings and concretions.

This soil is excellent for the general farm crops grown in the county, but it is likely to erode if it is used for crops that are tilled. Growing grasses and legumes periodically helps to maintain the structure of the soil and the content of organic matter. Contour stripcropping will help control erosion and conserve moisture. Diversion terraces can be used to remove excess surface water. A suitable rotation includes at least 1 year of hay every 3 years. Figure 8 shows this soil under cultivation.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 3; and group 1 for building sites.

Washington silt loam, 8 to 15 percent slopes (WgC).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is slightly thinner. Also, it is slightly shallower over glacial till or material weathered from limestone. Most of this soil is wooded and is only slightly eroded.

This soil is excellent for the general farm crops commonly grown in the county, but, if it is used for crops that are tilled, it is subject to serious erosion. Growing grasses and legumes periodically helps to maintain organic matter in the soil. Contour stripcropping would help control erosion and conserve moisture. Diversion terraces can be used to remove excess surface water. A suitable 4-year rotation includes at least 2 years of hay.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 3; and group 2 for building sites.

Washington silt loam, 8 to 15 percent slopes, moderately eroded (WgC2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is slightly thinner. There are also larger amounts of material from the subsoil mixed into the plow layer.

This soil is excellent for the farm crops commonly grown in the county. If it is cultivated, the soil is subject to erosion unless it is protected. Contour stripcropping and diversion terraces are needed to help control erosion and to conserve moisture. A suitable 4-year rotation includes at least 2 years of hay.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 3; and group 2 for building sites.

Washington silt loam, 8 to 15 percent slopes, severely eroded (WgC3).—The profile of this soil is like the one described as typical for the series, but its surface layer is thinner and contains more gravel and fragments of rock. Also, much larger amounts of material from the subsoil have been mixed into the plow layer. In some places the former subsoil is exposed.

This soil is better suited to hay, pasture, and trees than to tilled crops, but a tilled crop can be grown occasionally when it is necessary to reseed hay crops. When hay is reseeded, use contour strips to prevent erosion. Terraces can be used on long slopes to protect the soil from excessive runoff.

This soil is in capability unit IVe–1; woodland group 6; irrigation group 3; and group 2 for building sites.

Washington silt loam, 15 to 25 percent slopes, moderately eroded (WgD2).—The profile of this soil is similar to the one described as typical for the series, but it is shallower over glacial till or material weathered from sandstone. It also contains more gravel and fragments of rock.

In places there are small areas where this soil has steeper slopes and a thinner surface layer than the typical soil. There are also small areas near the bottom of steep slopes where the surface layer has become thicker because of deposition of soil material from higher areas.

Washington silt loam, 15 to 25 percent slopes, moderately eroded, is probably best suited to hay, pasture, or trees. A cultivated crop can be grown occasionally when hay needs to be reseeded. When hay is reseeded, use contour strips to help prevent severe erosion. The small, steep areas are best kept in trees.

This soil is in capability unit IVe–1; woodland group 5; irrigation group 3; and group 2 for building sites.

Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded (WcB2).—This soil has a profile similar to the one described as typical for the Washington series, but it is more gravelly throughout. The subsoil contains 30 percent more gravel and is redder.

There are some small, more nearly level areas where the surface layer is thicker than the one in the profile described because soil material has accumulated on the surface. In places, where the break in slope is sharp, the soil is severely eroded.

Washington gravelly loam, coarse variant, 3 to 8 percent slopes, moderately eroded, is excellent for orchards. It is suited to the general farm crops grown in the county, but it is subject to erosion if it is cultivated. Contour stripcropping and diversions can be used on the long slopes to help prevent further erosion. A suitable 5-year rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–1; woodland group 2; irrigation group 2; and group 1 for building sites.

Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded (WcC2).—The profile of this soil is similar to the one described as typical for the series, but it contains more gravel. The subsoil is more gravelly and more reddish, and it contains less silt and clay. In the subsoil there are large concentrations of rounded pebbles of shale, sandstone, and quartzite mixed with cobbles of sandstone.

In small areas the surface layer is thinner than that in the profile described, and it has a larger amount of material from the subsoil mixed into it. In a few places the soil is but little eroded and has a thicker surface layer.

Washington gravelly loam, coarse variant, 8 to 15 percent slopes, moderately eroded, is excellent for orchards. It is well suited to the general farm crops grown in the county, but it is subject to erosion if it is cultivated.

Growing grasses and legumes periodically helps to improve the structure of the soil and to maintain the content of organic matter. A suitable 4-year rotation includes at least 2 years of hay crops.

This soil is in capability unit IIIe–1; woodland group 5; irrigation group 2; and group 2 for building sites.

Wheeling Series

The Wheeling series consists of deep, well-drained soils on high terraces. The surface layer of these soils is very dark grayish-brown gravelly loam to silt loam. The subsoil is yellowish brown to strong brown and contains water-rounded gravel and cobbles of sandstone.

These soils developed in old alluvial material that was deposited by rivers that flowed through areas of many different kinds of soils. The soils are nearly level to gently sloping and lie 50 to 100 feet above the present stream level. They are adjacent to large streams.

The Wheeling soils are near the moderately shallow to deep, well-drained Trexler soils and the shallow Montevallo soils. They are also near the moderately well drained to somewhat poorly drained Comly soils.

Typical profile of Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded, in a cultivated area:

A_p 0 to 10 inches, very dark grayish-brown (10YR 3/2) gravelly loam; 10 percent coarse fragments; weak, fine, granular structure; friable when moist; neutral; abrupt, wavy boundary; 9 to 11 inches thick.

A_3 10 to 16 inches, dark-brown (10YR 4/3) gravelly loam; 15 percent coarse fragments; weak, medium, subangular blocky structure that breaks to weak, fine, granular; friable when moist; neutral; gradual, wavy boundary; 5 to 7 inches thick.

B_1 16 to 23 inches, dark-brown (7.5YR 4/4) gravelly silt loam; 15 percent coarse fragments; weak, medium, subangular blocky structure; friable when moist; thin clay films; neutral; gradual, wavy boundary; 6 to 9 inches thick.

B_{21} 23 to 30 inches, dark-brown (7.5YR 4/4) heavy silt loam; 15 percent coarse fragments; fine, blocky and subangular blocky structure; friable when moist; distinct clay films; slightly acid; clear, wavy boundary; 6 to 8 inches thick.

B_{22} 30 to 43 inches, yellowish-brown (10YR 5/6) gravelly fine silt loam; 20 percent coarse fragments; moderate, medium, subangular blocky structure; friable when moist; strongly acid; abrupt, irregular boundary; 10 to 15 inches thick.

B_3 43 to 58 inches, strong-brown (7.5YR 5/6) gravelly silty clay loam; 35 percent coarse fragments; moderate to fine, blocky structure; firm in place; well-developed, moderately thick clay films; black coatings of iron and manganese; strongly acid; 12 inches or more thick.

The color of the subsoil ranges from yellowish brown to dark brown, and the texture, from gravelly silt loam to gravelly silty clay loam. Where the soil has not been limed in recent years, the reaction in the upper part of the subsoil is medium acid to strongly acid instead of neutral.

These soils have moderate permeability in the subsoil and substratum. Their available moisture capacity and natural fertility are moderate.

Wheeling gravelly loam, 0 to 3 percent slopes (WhA).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is thicker and contains less gravel.

Mapped with this soil are areas where the surface layer is thinner than that in the typical soil. These areas are too small to be mapped separately.

Wheeling gravelly loam, 0 to 3 percent slopes, is well suited to the general farm crops grown in the county. Grasses and legumes need to be grown periodically to help maintain organic matter and the structure of the soil. Farming on the contour will help prevent erosion. Row crops and small grains can be grown frequently if cover crops are grown in winter and green-manure crops are grown regularly.

This soil is in capability unit I–2; woodland group 1; irrigation group 2; and group 1 for building sites.

Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded (WhB2).—The profile of this soil is like the one described as typical for the series. It contains many rounded pebbles of sandstone and quartzite mixed with some cobbles. The subsoil is well developed and consists of gravelly fine silt loam.

In places there are small areas in which the soil has a thicker surface layer than the typical soil. In a few places the soil is severely eroded.

Wheeling gravelly loam, 3 to 8 percent slopes, moderately eroded, is fair for the general farm crops commonly grown in the county, but, if it is used for tilled crops, it is subject to serious erosion.

Growing grasses and legumes periodically will improve the structure of the soil and will help maintain the content of organic matter. Contour stripcropping and diversion terraces are needed to prevent further erosion and to conserve moisture. Applying fertilizer helps to improve yields. A suitable 5-year rotation includes at least 1 year of hay every 3 years.

This soil is in capability unit IIe–2; woodland group 1; irrigation group 2; and group 1 for building sites.

Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded (WhC2).—The profile of this soil is similar to the one described as typical for the series, but its surface layer is slightly thinner and cobbles and pebbles are more numerous.

In places near the lower end of slopes are small areas where the soil has a thicker surface layer than typical. There are also small areas in which the soil has a thinner surface layer and many small gullies.

Wheeling gravelly loam, 8 to 15 percent slopes, moderately eroded, is fairly well suited to the general farm crops commonly grown in the county. It is subject to serious erosion, however, if it is used for tilled crops.

Growing grasses and legumes periodically builds up the structure of the soil and maintains the content of organic matter. Contour stripcropping and diversion terraces are needed to help prevent erosion and to conserve moisture. A suitable 4-year rotation includes at least 2 years of hay crops and at least 1 year of a cultivated crop.

This soil is in capability unit IIIe–2; woodland group 4; irrigation group 2; and group 2 for building sites.

Woodglen Series

The Woodglen series is made up of very poorly drained soils. These soils have a very dark gray surface layer. Their subsoil is very dark gray clay loam mottled with light brown and gray.

These soils developed in material weathered from gneiss and granite of the Byram and Pochuck formations. They are in depressions, swales, and drainageways in the southern part of the county.

The Woodglen soils are near the deep, well-drained Chester and the shallow Brandywine soils. They are also near the deep, moderately well drained to somewhat poorly drained Glenville and the deep, poorly drained Worsham soils.

Typical profile of Woodglen silt loam, 0 to 3 percent slopes, in a cultivated area:

A_p 0 to 10 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; friable when moist; moderately acid; gradual, wavy boundary; 8 to 10 inches thick.

B_{21g} 10 to 23 inches, very dark gray (N 3/0) clay loam; many, fine, prominent mottles of gray (N 6/0); strong, coarse, subangular blocky structure; very firm when moist; thick clay films on the surfaces of peds; slightly acid; abrupt, irregular lower boundary; 11 to 15 inches thick.

B_{22g} 23 to 31 inches, very dark gray (N 3/0) clay loam; many, fine, prominent mottles of light brownish gray (10YR 6/2), pinkish gray (7.5YR 7/2), and dark gray (N 4/0); strong, coarse, blocky structure; very firm when moist; moderately thick clay films; moderately acid; gradual, wavy boundary; 7 to 10 inches thick.

B_{23g} 31 to 36 inches, pale-brown (10YR 6/3) clay loam; many, medium, prominent mottles of yellowish red (5YR 4/8); very coarse, prismatic structure; friable when moist; slightly acid; gradual, wavy boundary; 5 to 7 inches thick.

C_1 36 to 50 inches +, pale-brown (10YR 6/3) fine sandy loam; common, fine, prominent mottles of pale brown (5YR 4/8); weak, coarse, prismatic structure to massive; friable when moist; slightly acid; 14 or more inches thick.

The color of the subsoil ranges from very dark gray to pale brown, and the texture, from sandy clay loam to clay loam. Depth to mottling ranges from 8 to 12 inches.

The permeability of these soils is slow in the subsoil and very slow in the substratum. The available moisture capacity and natural fertility are moderate.

The Woodglen soils are not suited to cultivated crops, and they are only fairly well suited to pasture.

Woodglen silt loam, 0 to 3 percent slopes (WoA).—The profile of this soil is like the one described as typical for the series. The soil is but little eroded. Its subsoil is prominently mottled, but the profile is nearly free of fragments of rock.

In places there are small areas in which the surface layer is thinner than that of the typical soil.

Unless it is drained, Woodglen silt loam, 0 to 3 percent slopes, is suited to only limited use for cultivated crops, hay crops, pasture, and trees. Grasses and legumes that tolerate wetness are the best plants to grow. Open ditches can be used to lower the water table and to improve drainage. Then, a wider variety of crops can be grown.

This soil is in capability unit IIIw–1; woodland group 11; and group 12 for building sites.

Woodglen silt loam, 3 to 8 percent slopes (WoB).—The profile of this soil is like the one described as typical for the series, but depth to mottling is slightly greater and surface drainage is better. The surface layer contains a few fragments of rock.

This soil is probably best suited to hay, pasture, or trees, but it can be cultivated occasionally. Grasses and legumes that tolerate wetness are the best plants to grow. Open ditches are needed to improve drainage and to remove excess surface water. Generally, yields of forage crops increase when drainage is improved.

This soil is in capability unit IIIw–1; woodland group 11; and group 12 for building sites.

Woodglen very stony silt loam, 0 to 8 percent slopes (WrB).—The profile of this soil is like the one described as typical for the series, but it is very stony. In some places slopes are steep.

This soil is probably best suited to trees. It is too stony and wet for other agricultural purposes. Trees that tolerate wetness are the best to plant on areas that need replanting.

This soil is in capability unit VIIs–2; woodland group 11; and group 12 for building sites.

Worsham Series

The Worsham series consists of deep, poorly drained soils of uplands. The soils have a surface layer of dark grayish-brown silt loam. Their subsoil is light-gray to white clay loam or sandy clay loam that is very sticky when wet and very hard when dry. The soils formed mostly in materials weathered from granitic gneiss.

These soils are in low places in the southern part of the county. In many places they are near the deep, well drained Chester, and the deep, moderately well drained to somewhat poorly drained Glenville soils. They are also near the very poorly drained Woodglen and the shallow, well-drained Brandywine soils.

Typical profile of Worsham silt loam, 0 to 3 percent slopes, moderately eroded in a cultivated area:

A_p 0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam; medium, blocky structure; friable when moist, slightly sticky when wet; moderately acid; gradual, wavy boundary; 6 to 8 inches thick.

A_{2g} 6 to 12 inches, dark-gray (10YR 4/1) sandy loam; 40 percent mottled with many, medium, distinct mottles of light brownish gray (10YR 6/2); weak, fine, granular structure; very friable when moist, nonsticky when wet; medium acid; abrupt, smooth boundary; 5 to 7 inches thick.

B_{1g} 12 to 23 inches, light-gray (10YR 7/1) clay loam; 35 percent mottled with many, coarse, prominent mottles of strong brown (7.5YR 5/8); strong, coarse, angular blocky structure; firm when moist, very sticky when wet; medium acid; gradual, wavy boundary; 9 to 13 inches thick.

B_{3g} 23 to 29 inches, white (10YR 8/2) sandy clay loam; 30 percent mottled with yellowish brown (10YR 5/8);

strong, coarse, angular blocky structure; firm when moist, very sticky when wet; medium acid; gradual, wavy boundary; 5 to 7 inches thick.

C_{gm} 29 to 48 inches +, white (10YR 8/2) sandy clay loam that is mottled with yellowish brown (10YR 5/8); massive; firm in place, loose when disturbed, sticky when wet; medium acid.

The texture ranges from fine silt loam to gravelly sandy loam. Except in summer and early in fall, the water table is at or near the surface. Permeability is slow to very slow in the subsoil and substratum. Tilth is generally fair to poor. Natural fertility is medium, but the root zone is too shallow for most plants to grow well.

Much of the acreage of these soils is in pasture and trees, and only a few acres are in crops. The woodlands have been cut over several times for lumber.

Worsham silt loam, 0 to 3 percent slopes (WsA).—This soil is in depressions and in nearly level areas in small valleys. The profile is similar to the one described as typical for the series, but the surface layer is somewhat thicker. The subsoil is mottled and remains wet late in spring.

This soil has slow to very slow permeability in the subsoil and substratum. It has moderately low available moisture capacity and medium natural fertility.

This soil is fairly well suited to hay, pasture, and trees. Alsike and ladino clovers and reed canarygrass can be grown, but most of this soil is used for bluegrass pasture.

Using open drainage ditches to lower the water table will improve this soil for plants. Diversion terraces can be used at the base of adjoining slopes to divert runoff.

This soil is in capability unit Vw–1; woodland group 11; and group 12 for building sites.

Worsham silt loam, 0 to 3 percent slopes, moderately eroded (WsA2).—The profile of this soil is similar to the one described as typical for the series. The soil has lost from one-fourth to three-fourths of its original surface layer through erosion.

This soil has slow permeability in the subsoil and substratum. Consequently, the root zone is too shallow for most plants to grow well. Natural fertility is medium.

If this soil is drained and fertilizer is added, it can be used for pasture. The soil is well suited to alsike and ladino clovers and reed canarygrass grown for pasture.

Major reclamation is generally needed to provide adequate drainage. The subsoil is too tight and clayey for tile drains, but open drains can be used. Using diversion terraces at the foot of adjoining slopes or hills will help prevent damage by runoff. If this soil is grazed when wet, the trampling of livestock damages the structure of the soil. Maintaining the content of organic matter will help to prevent damage by compaction.

This soil is in capability unit Vw–1; woodland group 11; and group 12 for building sites.

Worsham silt loam, 3 to 8 percent slopes (WsB).—The profile of this soil is similar to the one described as typical for the series, but depth to mottling is somewhat greater. Only a small amount of soil material has been deposited on this soil from other areas. Permeability is slow in the subsoil, and natural fertility is medium.

This soil is suited to trees and to timothy, alsike and ladino clovers, bluegrass, reed canarygrass, and birdsfoot trefoil. It is subject to erosion unless it is protected. Excessive wetness, which is difficult and costly to overcome, is the major hazard.

Closed random drains can be used in some seep areas to improve drainage, but tile drains are generally impractical to use. Diversion terraces will help to protect this soil from excess water from higher slopes.

This soil is in capability unit Vw–1; woodland group 11; and group 12 for building sites.

Worsham silt loam, 3 to 8 percent slopes, moderately eroded (WsB2).—The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner and depth to mottling is somewhat greater.

This soil has a slowly permeable subsoil. It is generally wet, but its available moisture capacity is moderately low. The soil has medium natural fertility.

If this soil is drained and fertilizer added, a limited amount of forage can be obtained from pasture plants grown on it. The excessive wetness is difficult to remedy.

Closed random drains can be used in some seep areas to improve drainage. In other areas open ditches can be used to lower the water table and to improve the areas for plants. Diversion terraces are needed to dispose of excess water from higher slopes. This soil is easily compacted, and, if it is grazed or driven over when wet, it will be made even more nearly impervious.

This soil is in capability unit Vw–1; woodland group 11; and group 12 for building sites.

Formation and Classification of the Soils

In this section the factors that have affected the formation of the soils in Lehigh County are discussed. Also discussed is the classification of the soils by higher categories.

Formation of Soils

Soils are mixtures of fragmented and partly or completely weathered rocks, minerals, organic matter, water, and air that occur in varying proportions. They have more or less distinct horizons that formed under the influence of the soil-forming factors of their environment. The important factors in the formation of soils are the parent material, the climate, the relief or lay of the land, the plant and animal life, and time. The kind of soil that forms in any given environment depends on the interaction of these five factors.

Soil formation begins with physical weathering. Large pieces of rock are broken into smaller pieces by frost wedging, differential expansion, unloading, colloidal plucking, hydration, and other forces, and the rocks and fragments of rock are reduced to the size of particles of sand and silt. In this way, an unconsolidated layer of material is formed in which plants can grow. Organic matter is added to the material when plants and animals die.

Chemical weathering of rock fragments and organic matter occurs by solution, carbonation, oxidation, reduction, and the action of weak acids. The rock fragments are reduced to particles of the size of clay. Also, nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, iron, molybdenum, zinc, manganese, and other elements are released for plants to use.

In Lehigh County the kind of rock from which the *parent material* developed has had an important effect on the kind of soil that has formed, although glaciation has somewhat modified its effect. This is because climate and vegetation were fairly uniform throughout the county, and this lack of variation tended to make the factor of parent material appear dominant. The character of the parent material influences the kind of changes that take place during the weathering process and also the speed of the weathering. Soil develops very slowly from solid bedrock but develops fairly rapidly in sand, silt, gravel, and other unconsolidated material.

Climate affects the formation of soils by influencing the rate of weathering and the decomposition of minerals. Soils generally develop more rapidly and weather more completely in a warm climate than they do in a cold one. Climate influences the kind of vegetation that grows on soils, and the moisture that falls and the temperature greatly affect the kind of soil that is formed. Climate also affects leaching and the translocation of weathered materials.

Relief affects the rate of surface drainage and the movement of water through the soil. The degree of geologic erosion that has taken place was determined, in part, by the rate of surface drainage. Drainage has also influenced the rate and depth to which rock has weathered. Generally, the soils on steep slopes are shallow, and those on gentle slopes are deep.

Plant and animal life are active in the soil-forming processes. The changes that plants, micro-organisms, earthworms, and others forms of life on and in the soil bring about depend mainly on the life processes peculiar to each. The kinds of plants and animals are determined by the climate, parent material, relief, and age of the soil, and by the presence of other organisms. In this county the vegetation consisted of grass, of broad-leaved deciduous trees, and of coniferous trees.

The length of *time* the other factors of soil formation have been operating is indicated, to some extent, by the degree of development of the soil profile. In this county differences in time have not been responsible for most of the differences in the kind and distinctness of horizons. Such differences have been caused mainly by varying combinations of parent material, relief, and plant and animal life.

Processes of soil formation

In the soil profile gains and losses are two of the processes that cause differences in the horizons. Ordinarily, gains to the soil are made in the form of organic matter, minerals, or nutrient elements. Losses from the soil occur when minerals are dissolved and leached from the soil in solution, nutrient elements are removed by plants, the finer particles of the soil are removed by erosion, and gases escape when organic matter decomposes.

Transfer of material from one part of the soil to the other is common in most soils. Organic matter is moved from one part of the profile to another in suspension or solution. Calcium is leached from the surface layer and is held by the clay in the subsoil or lower part of the profile, and it is also held in the parent material. Bases are moved when they are absorbed by plant roots and stored in the stems, leaves, and twigs of plants. When the plants die and decay, they return the calcium and other elements to the soil that were formerly stored in their stems, leaves, twigs, and roots.

As chemical weathering takes place, transformations occur. An example is the release of iron, aluminum, calcium, and other elements from the primary and secondary minerals in the soil (*22*). In a well-drained soil yellow, brown, and red colors gradually replace the gray or blue colors of the relatively unweathered materials as they are exposed to weathering. The colors indicate the release of iron or the oxidation of ferrous oxides to ferric oxides in the presence of adequate supplies of oxygen.

The soil profile

As the soil develops, layers, called horizons, are formed. These gradually develop properties that are recognizable and can be identified in the soil.

Under forest vegetation the first horizons to become recognizable are usually the dark-colored layers, called the A_0 horizon, where organic matter has accumulated. The surface layer, a dark-colored horizon, is called the A_1 horizon. As soluble materials are removed, a light-colored, eluviated layer generally develops under the layer that is stained with organic matter. The quartz and other resistant minerals that remain form a light-colored layer called the A_2 horizon.

In time, there generally develops under the light-colored horizon a stronger colored subsoil, or B horizon, which may or may not be finer textured than the surface horizons. This layer is formed by the alteration in place or by washing in, or illuviation, of clay, iron, aluminum, and other compounds that have been released by weathering in the upper part of the solum or that moved down from the A horizon.

Deeper in the profile, the B horizon is lighter colored and in most places coarser textured, and it finally blends with the unconsolidated material weathered from the bedrock or other parent material. This layer, the C horizon, presumably is made up of the same kind of material as that from which the soil developed. It is not a part of the true soil, or solum, which is composed of the A and B horizons.

Classification of the Soils

The soils of Lehigh County have been grouped according to two classification systems. These are the great soil group and the soil catena. They are discussed in the following pages.

Great soil groups

A great soil group consists of soils that are similar in several fundamental characteristics. They have the same kinds and numbers of horizons, although corresponding horizons are not necessarily of the same thickness, nor are they expressed with the same degree of clarity. In some characteristics the soils of any given group may differ considerably. Many soils have some of the significant characterstics of more than one great soil group and are called intergrades.

The soil series of Lehigh County are classified by great soil groups according to the classification given in the 1938 Yearbook of Agriculture (*18*) and modified by Thorp and Smith (*16*). The Sols Bruns Acides are described by Baur and Lyford (*3*).

The great soil groups, the intergrades, and the soil series in each are discussed in the pages that follow. A detailed description of a profile for each soil series is given in the section "Descriptions of the Soils."

Gray-Brown Podzolic soils.—In this county the Ryder soils are representative of the Gray-Brown Podzolic great soil group. The soils of this group formed under a deciduous forest in a humid, temperate climate. Geographically, they lie between the Podzols, which are to the north, and the Red-Yellow Podzolic soils, which are to the south. A typical soil of this group in an undisturbed area has a thin litter of leaves on the surface. Below the layer of leaves is a dark grayish-brown layer of humus that is 1 to 2 inches thick. This is underlain by a grayish, leached layer that extends to a depth of 8 to 12 inches. When the soil is plowed, the soil material in these two layers is mixed together and forms a dark-brown plow layer, or A_p horizon. The B horizon, or subsoil, is distinctly finer textured and brighter colored than the A horizon, or surface soil. The subsoil is lighter colored and coarser textured where it grades to a partially weathered layer, or C horizon.

The Gray-Brown Podzolic soils are generally less weathered than the Red-Yellow Podzolic soils. As a rule, they contain more mineral elements that dissolve or decompose more easily than do the Red-Yellow Podzolic soils, but they are less acid. Base saturation increases with depth in the Gray-Brown Podzolic soils, and the parent material is calcareous in many places.

The productivity of the Gray-Brown Podzolic soils varies considerably, depending on the texture and other characteristics of the parent material, but these soils generally are very productive. Crops on these soils respond well if lime and fertilizer are added.

Gray-Brown Podzolic soils (intergrading toward Red-Yellow Podzolic soils).—Some of the soils in the county have characteristics of both the Gray-Brown Podzolic and Red-Yellow Podzolic great soil groups. They are classified as Gray-Brown Podzolic soils intergrading toward the Red-Yellow Podzolic great soil group. These soils belong to the Bedford, Chester, Comly, Duffield, Elk, Fleetwood, Glenville, Murrill, Norton, Readington, Washington, and Wheeling series.

The soils in this group have the same sequence of horizons as the Gray-Brown Podzolic soils, and their solum is of the same thickness. They also have a similar color and are similar in textural and structural development. These soils are acid and have low base saturation like the Red-Yellow Podzolic soils, however, and they have few easily weathered primary minerals.

Generally, the soils of this group are productive. Crops grown on them respond well if lime and fertilizer are added. The Comly and Readington soils, however, have a fragipan or dense layer of clay and silt that is weakly cemented in places. This layer impedes the downward movement of water and hinders the development of plant roots.

Gray-Brown Podzolic soils (intergrading toward Lithosols).—The soils of the Penn series are the only Gray-Brown Podzolic soils in this county that intergrade toward Lithosols. These soils have the same physical and chemical properties as Gray-Brown Podzolic soils, and their major horizons are the same. They are moderately deep to shallow over bedrock, however, and their subsoil is weakly expressed. The subsoil also contains many fragments of rock. In most places the Penn soils consist of a layer that has been plowed, called an A_p layer, that is underlain by a thin, faint B horizon that grades to a horizon of rock fragments mixed with soil material. The bedrock is generally less than 24 inches from the surface.

Red-Yellow Podzolic soils.—The soils of the Buchanan, Laidig, and Monongahela series are in the Red-Yellow Podzolic great soil group. Red-Yellow Podzolic soils are highly leached. They are naturally acid and are low in readily soluble primary minerals. The clay minerals are commonly kaolinite and other stable 1 to 1 layer minerals. Generally, the soils of this group contain less organic matter than the Gray-Brown Podzolic soils.

In undisturbed areas the Red-Yellow Podzolic soils typically have a thin, dark-colored, organic-mineral A_1 horizon, but in plowed areas the surface layer is thick and is generally lighter colored. These soils have a light-colored, leached A_2 horizon in areas that have not been disturbed. Their B horizon generally is finer textured than the A_2 and has strong reddish or yellowish colors with a chroma of 6 or 8. The C horizon is generally weathered to a depth of many feet.

Red-Yellow Podzolic soils are moderate to low in natural fertility, but they are easy to till. They are suited to a wide range of crops, and the crops respond well when lime and fertilizer are added. The Buchanan and Monongahela soils, however, have a fragipan, or dense layer, of silt and clay that is weakly cemented. This layer impedes the downward movement of water and hinders the development of plant roots.

Red–Yellow Podzolic soils (intergrading toward Reddish-Brown Lateritic soils).—In this county the Montalto soils are the only ones classified as Red-Yellow Podzolic soils intergrading toward Reddish-Brown Lateritic soils. These soils are leached and are medium acid. They contain a moderate amount of minerals that are easily soluble and easily weathered. Clay minerals are commonly of the 1 to 1 layer lattice type with small amounts of 2 to 1 lattice clay minerals. Generally, these soils are less acid and are redder than the Red-Yellow Podzolic soils, and they are higher in free iron oxides.

In undisturbed areas these soils generally have a thin, dark-colored, organic-mineral A_1 horizon. The A_2 horizon is grayish brown to brown and is slightly coarser textured than the subsoil, or B horizon. The B horizon is dark reddish-brown to red or yellowish-red silty clay to clay, and its structure is moderately developed. The solum is generally 36 to 48 inches thick over a thin C horizon.

These soils are moderate to high in natural fertility. They are well suited to a wide range of crops, and the crops respond well if lime and fertilizer are added. In areas where erosion has exposed the clayey subsoil, however, these soils are difficult to manage.

Lithosols.—In this group are soils of the Klinesville and Montevallo series. Typically, Lithosols are shallow over bedrock and lack a well-developed soil profile. These soils are generally steep and are strongly influenced by parent material or relief. They generally consist of a plow layer underlain by shattered or relatively solid bedrock.

Little or no clay has accumulated in the solum of these soils. In places, where the bedrock is shattered to a depth of several feet, the color of the horizons may differ. In

many of the steep areas, bedrock is within the plow layer. Coarse fragments of rock make up 60 to 90 percent of the soil profile.

Sols Bruns Acides.—In this county the Brandywine and Trexler soils are classified in the Sols Bruns Acides great soil group. These soils formed in silty or sandy material. Typically, they have a thin A_1 horizon and a weakly expressed A_2 horizon. The B horizon contains but little more clay than the horizons above and below. It is distinguished chiefly by color, being redder than either the A or C horizons. In many soils there is little difference in color or texture between the A and B horizons. Weathering has taken place in these soils, but little movement of iron or clay has occurred.

The soils of this great soil group are likely to be droughty. Crops grown on them, however, respond well if lime and fertilizer are added.

Planosols.—In this county the Croton series is the only member of the Planosols great soil group. Planosols reflect the influence of local factors of relief or parent material. Typically, they have one or more horizons that are abruptly separated from and that contrast to an adjacent horizon because of high content of clay, compactness, or cementation. The B horizon is much higher in clay than the A horizon. The soils of this group are level or nearly level. They are poorly drained and have a high water table.

Low-Humic Gley soils.—In this great soil group are the Andover, Atkins, Melvin, Shelmadine, and Worsham soils. These soils are mostly nearly level and have a high water table. Surface drainage is slow because of the lack of slope and the slow permeability of the soil material.

These soils are somewhat poorly drained to poorly drained. Their A horizon is moderately high in organic matter and overlies a gray A_2 horizon. Their subsoil is generally fine textured. It is grayish brown to yellowish brown and has mottles that are gray, brown, or rust colored. In the poorly drained soils, the colors are predominantly gray. In areas that have been plowed, the surface layer contains more organic matter than that in the somewhat poorly drained soils, and it generally has a darker color.

Humic Gley soils.—In this county the Woodglen are the only soils in this great soil group. These soils are level or nearly level and are very poorly drained. They are at the foot of slopes, in drainageways, and in depressions where surface water or water from seepage collects and keeps the water table high. Generally, these soils are fine textured, which further impedes the downward movement of water.

These soils are waterlogged most of the time. As a result, organic matter accumulates in the surface layer and makes that horizon thick and black. The subsoil is saturated; it is neutral gray in color and has a few scattered mottles of reddish brown.

These soils are not suited to crops unless they are drained. Even if these soils are drained, they are likely to be difficult to manage.

Alluvial soils.—In this great soil group are soils of the Huntington, Lindside, and Philo series. These soils are on bottom lands along rivers and creeks, where they receive additional sediments because of frequent floods. The soil material has not been in place long enough for well-developed horizons to form. In most places the soil material consists of fairly uniform silt loam to a depth of 3 feet or more, but in many places it contains strata of clayey or gravelly material. Generally, the surface layer of these soils is dark colored, and the lower layers are brown.

These soils are well drained or moderately well drained. Crops grown on them respond well if lime and fertilizer are added.

Soil catenas

A catena is a group of soils formed from similar parent material but with unlike soil characteristics because of differences in relief and drainage. It is a practical grouping of soils that are closely associated with each other on the landscape. Table 8 shows the soils of Lehigh County grouped into catenas.

Laboratory Data

Selected soils of the five main soil series in Lehigh County were sampled in the field for detailed analyses.[4] Two samples were taken of the soil types studied. The samples were obtained from typical soils in the most common land use. A pit was dug through the solum and into the parent material, and samples were collected from each horizon that could be recognized. The analytical methods used are discussed in the following paragraphs.

Methods of Analyses

In all the chemical procedures used, air-dry samples were crushed with a rolling pin so that the material would pass through a round-hole sieve. Care was taken to avoid breaking the nonsoil material into fragments so small that they would pass through the 2-millimeter sieve. The percentage, by weight, of fragments coarser than 2 millimeters was determined. All laboratory determinations, except those for bulk density and moisture retention at ⅓ atmosphere tension, were made on the part of the sample consisting of soil material less than 2 millimeters in diameter, and results are reported on that basis.

Particle size was determined by the pipette method with dispersion by sodium hexametaphosphate and by mechanical shaking (*7, 8*).

Bulk density, expressed in grams per cubic centimeter, was determined on 1- by 2-inch cylindrical core samples. The samples were taken with the Salinity Laboratory modified Uhland core sampler (*17, 21*).

In the samples examined moisture retained at ⅓ atmosphere tension was determined with the pressure plate apparatus, on the core samples (*21*). Moisture retained at 15 atmospheres tension was determined by using the pressure plate and pressure membrane apparatus on the fragmented samples (*12*).

Organic carbon was determined by using a modification of the Walkley-Black method (*11*). A semimicro adaptation of the Kjeldahl method (*2*) was used to determine total nitrogen. When this method is used, the sample is digested in a mixture of potassium sulfate and concentrated sulfuric acid, using selenium metal and copper

[4] Laboratory analyses were conducted by R. P. MATELSKI, C. F. ENGLE, E. C. MASON, and the staff at the Soil Characterization Laboratory of the Pennsylvania State University.

sulfate as catalysts. Ammonia is then distilled and collected in boric acid and titrated with sulfuric acid.

Exchangeable hydrogen, calcium, magnesium, and the cation exchange capacity were determined by extraction with neutral normal ammonium acetate (*11*). The cation exchange capacity was determined by summation of the exchangeable cations. Exchangeable sodium and potassium were determined by using a model 52a Perkin-Elmer flame photometer.

The information obtained by these analyses can be used to check field observations made by less precise methods, such as the determination of texture by feel. The physical

TABLE 8.—*Soil catenas in Lehigh County*

Landform and principal kind of parent material	Well drained			Moderately well drained	Somewhat poorly drained	Poorly drained
	Shallow soils	Moderately deep soils	Deep soils			
SOILS ON UPLANDS						
Till from gray shale and sandstone, or frost-churned gray shale, siltstone, and sandstone and frost-churned or water-worked fragments from very fissile, thin-bedded, red and gray shale of the Martinsburg formation.	Montevallo	Trexler, moderately shallow.	Trexler	Comly	Comly,[1] Shelmadine.[2]	Shelmadine.
Residuum from hard, red shale of the Martinsburg formation.	Klinesville	Klinesville				
Till or frost-churned material from quartzite and sandstone.		Fleetwood	Fleetwood			
Till or frost-churned material from granite and gneiss.	Brandywine.	Chester	Chester	Glenville	Glenville,[1] Worsham.[2]	Woodglen,[3] Worsham.
Till or frost-churned material from limestone.			Washington	Bedford	Melvin, local alluvium.	Melvin, local alluvium.
Residuum from impure limestone		Duffield	Duffield			
Frost-churned residuum and residuum from cement rock (Jacksonburg formation).	Ryder	Ryder	Duffield, low clay variant.	Bedford	Lawrence	
Residuum from Red Triassic shale and sandstone.	Penn	Penn	Norton	Readington	Croton,[2] Readington.[1]	Croton.
Residuum from Triassic diabase			Montalto			
Colluvium from quartzite, sandstone, and shale at the foot of Blue Mountain.			Laidig	Buchanan	Buchanan,[1] Andover.[2]	Andover.
Colluvium from quartzite, granite, and gneiss underlain by limestone; at the foot of South Mountain.			Murrill			
SOILS ON TERRACES						
Coarse-textured glacial outwash along the Lehigh River; acid throughout.			Wheeling			
Medium-textured material from limestone and shale; neutral to slightly acid.			Elk			
Fine-textured silt and clay from gray shale with some limestone.				Monongahela.		
SOILS ON FLOOD PLAINS						
Alluvium from acid, gray shale, sandstone, gneiss, granite, and igneous rocks.				Philo	Philo,[1] Atkins.[2]	Atkins.
Alluvium from limestone and calcareous shale.			Huntington	Lindside	Lindside,[1] Melvin.[2]	Melvin.

[1] This series is in the drier part of the drainage range.
[2] This series is in the wetter part of the drainage range.
[3] Very poorly drained.

data can be used to determine the engineering properties of soils, their response to tillage, and their ability to absorb, transmit, and store moisture for plants to use.

The chemical tests indicate the degree of leaching of the soils and their ability to hold and to furnish plant nutrients. The tests are also helpful in determining the amount of liming materials needed to adjust the acidity of the soil. Extractable cations give a basis to estimate the fertility of the soil.

The characteristics of soils, such as texture, reaction, and the percentage of base saturation, are used in placing soils in the higher categories of the soil classification system. The analytical data for each layer of soil in the various profiles sampled are given in table 9.

Summary of Laboratory Data

Some results of the laboratory analyses of the soils sampled are summarized in the pages that follow.

Chester Gravelly Silt Loam

The horizons in the two profiles of Chester soil are medium textured to a depth between 3 and 4 feet. Below that depth, they are coarser textured. In about the upper 3 feet, the content of sand is between 29 and 46 percent, except that the A_p horizon of one profile contains only 8 percent of sand. Below a depth of 3 or 4 feet, the content of sand increases. The coarsest sand fractions generally consist of rock fragments and of larger crystals of quartz. The content of coarse fragments larger than 2 millimeters in diameter ranges from 18 to 41 percent.

The presence of a textural B horizon is shown by the content of clay in the horizons between a depth of 10 and 20 inches in one profile and at a depth of 13 to 29 inches in the other profile. The Chester soils have a more strongly expressed textural B horizon than the Trexler soils, but one less well developed than the one in the Washington soils. The smaller amounts of clay and silt below a depth of 41 inches in one profile, and below a depth of 49 inches in the other, suggest that the material at that depth is a C horizon. Unconsolidated material that apparently has weathered in place from the underlying bedrock extends 10 to 15 feet or more below the solum.

The difference between moisture held at 1/3 atmosphere tension and at 15 atmospheres tension ranges from 6 to 12 percent. The solum is deep enough to hold a moderate to large amount of moisture.

The profiles of the two Chester soils sampled are medium acid to slightly acid; the reaction is fairly constant throughout the profile or decreases slightly with increasing depth. These soils either have not been markedly affected by the application of lime, or the effect has been uniform throughout the profile.

Base saturation follows the general pattern of the pH values; it ranges from 54 to 64 percent in the two profiles sampled. In one of the soils, the proportion of base saturation decreases with increasing depth, and in the other it increases. The cation exchange capacity ranges from 11 to 19 and indicates a moderate ability to hold and release nutrients to plants. Organic carbon in these two profiles is high in the A_p horizon as the result of cultivation and the adding of crop residues. The amount of organic carbon in the profile generally becomes smaller with increasing depth.

Duffield Silt Loam, Low Clay Variant

In the two profiles of Duffield silt loam, low clay variant, the horizons are medium to moderately fine textured. The content of sand ranges from 7 to 26 percent and is generally greatest in the deepest horizons. The number of coarse fragments is low, except in the C_1 horizon of sample S59Pa–39–9, where 56 percent of the horizon consists of coarse fragments.

A sharp increase in the content of clay in the horizons at a depth below 10 inches indicates that there is a textural B horizon. The texture in the subsoil of the two profiles ranges from silty clay loam to silt loam. The smaller amount of clay and silt below a depth of 57 inches in the first profile and below a depth of 53 inches in the other indicates the upper boundary of a C horizon.

The difference between moisture held at 1/3 atmosphere tension and at 15 atmospheres tension is fairly high. Because of the thickness of the solum and the silty texture of the profiles, the moisture-holding capacity is high.

In sample S59Pa–39–8 the base saturation for the profile is generally less in the deepest horizons, but it increases slightly in the C horizon. In profile S59Pa–39–9 the base saturation is greater in the lower two horizons and in the C_1 horizon.

The pH values of the two profiles range from strongly acid to neutral and follows the base saturation curve. In sample S59Pa–39–8 the reaction is neutral, probably because liming materials have been applied to the soil or because dust has blown onto the areas from nearby cement mills. In both profiles the pH is lower in the deepest horizons than in horizons nearer the surface.

The cation exchange capacity is fairly high in these profiles. The highest values are in the A_p horizon and are related to the content of organic matter in that layer. In both samples the cation exchange capacity decreases below the A_p horizon, but in sample S59Pa–39–8, the exchange capacity remains about the same after a decrease in the B_1 horizon. The soils have adequate exchange capacity for holding and releasing nutrients to plants. Organic carbon is high in the A_p horizon, but it decreases sharply with increasing depth, probably because much organic matter has been mixed into the surface layer.

Montevallo Channery Silt Loam

The horizons in the two profiles of Montevallo soils are medium textured, except that in one profile the texture is moderately coarse at a depth below 11 inches. The content of sand ranges from 32 to 67 percent and is generally greatest in the deepest horizon. The amount of coarse fragments is large.

These soils have a weakly expressed or discontinuous textural B horizon. In sample S59Pa–39–6 the content of clay is less in the horizons between 9 and 16 inches than in the A_p horizon. In sample S59Pa–39–1 there is a sharp increase in clay in the layer between 7 and 11 inches, but below that depth there is less clay. The smaller amounts of clay and silt below a depth of 16 and 11 inches, respectively, and the greater amount of sand and coarse fragments suggest that the material there is a C horizon.

TABLE 9.—*Mechanical and chemical*

[Dashes in columns indicate sample

Soil name and sample number	Horizon	Depth	Particle-size distribution							Coarse fragments (greater than 2 mm.)	Textural class
			Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.5 mm.)	Medium sand (0.5 to to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (less than 0.002 mm.)		
Chester gravelly silt loam:		*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percentage by weight*	
S59Pa-39-13-1	A_p	0–10	1.5	2.7	2.2	1.5	1.9	76.0	14.2	25.4	Silt loam
S59Pa-39-13-2	B_1	10–14	7.9	9.6	7.3	5.6	3.6	45.4	20.6	24.6	Loam
S59Pa-39-13-3	B_{21}	14–20	7.9	9.3	7.4	6.1	4.2	46.8	18.3	32.2	Loam
S59Pa-39-13-4	B_{22}	20–26	8.9	11.1	9.2	8.7	6.1	42.5	13.5	28.8	Loam
S59Pa-39-13-5	B_{23}	26–36	8.8	11.9	10.3	8.9	6.0	42.8	11.3	29.7	Loam
S59Pa-39-13-6	B_3	36–41	12.1	15.3	11.8	10.7	6.7	31.4	12.0	23.2	Coarse sandy loam.
S59Pa-39-13-7	C_1	41–50+	15.0	18.9	17.4	11.4	5.7	23.0	8.6	23.0	Coarse sandy loam.
S59Pa-39-14-1	A_p	0–13	5.6	8.0	7.4	7.5	5.5	52.4	13.6	26.7	Silt loam
S59Pa-39-14-2	B_1	13–18	4.5	6.8	6.4	5.9	5.1	54.3	17.0	22.1	Silt loam
S59Pa-39-14-3	B_{21}	18–23	4.5	6.0	5.9	6.2	5.1	50.8	21.5	23.1	Silt loam
S59Pa-39-14-4	B_{22}	23–29	5.6	7.1	8.5	8.7	6.9	41.2	22.0	25.3	Loam
S59Pa-39-14-5	B_{23}	29–36	4.1	8.0	9.4	11.5	8.8	38.3	19.9	22.2	Loam
S59Pa-39-14-6	B_{24}	36–40	5.2	8.5	10.1	11.7	8.8	36.4	19.3	29.7	Loam
S59Pa-39-14-7	B_3	40–49	8.0	12.6	11.1	11.2	8.2	32.0	16.9	41.3	Loam
S59Pa-39-14-8	C_1	49–54	8.5	12.5	13.2	14.6	9.2	26.3	15.7	17.8	Sandy loam
Duffield silt loam, low clay variant:											
S59Pa-39-8-1	A_p	0–10	.7	1.4	1.9	2.3	3.0	69.4	21.3	2.7	Silt loam
S59Pa-39-8-2	B_1	10–14	.9	1.1	1.3	1.6	2.3	64.9	27.9	4.1	Silty clay loam
S59Pa-39-8-3	B_{21}	14–20	.7	1.0	1.2	1.5	2.4	62.9	30.3	3.1	Silty clay loam
S59Pa-39-8-4	B_{22}	20–27	.4	1.5	1.6	2.0	2.7	65.0	26.8	3.8	Silt loam
S59Pa-39-8-5	B_{23}	27–33	.7	1.4	1.6	2.0	2.8	65.5	26.0	3.2	Silt loam
S59Pa-39-8-6	B_{24}	33–40	1.0	1.9	1.5	1.6	2.7	67.9	23.4	2.5	Silt loam
S59Pa-39-8-7	B_{25}	40–47	1.0	2.1	2.2	2.5	3.2	65.0	24.0	5.3	Silt loam
S59Pa-39-8-8	B_3	47–57	2.8	4.2	3.9	5.4	6.3	56.9	20.5	4.0	Silt loam
S59Pa-39-8-9	C_1	57–66	3.5	4.6	4.4	5.8	7.0	58.2	16.5	5.7	Silt loam
S59Pa-39-8-10	C_2	66+	.6	1.7	2.0	3.3	4.6	67.2	20.6	1.8	Silt loam
S59Pa-39-9-1	A_p	0–10	1.6	2.1	1.9	2.3	2.5	63.4	26.2	11.1	Silt loam
S59Pa-39-9-2	B_1	10–14	2.1	2.3	1.8	1.9	2.3	57.7	31.9	10.0	Silty clay loam
S59Pa-39-9-3	B_{21}	14–22	2.1	2.3	2.2	2.5	3.0	56.7	31.2	7.6	Silty clay loam
S59Pa-39-9-4	B_{22}	22–28	1.8	2.6	2.3	2.7	3.6	58.1	28.9	7.4	Silty clay loam
S59Pa-39-9-5	B_{23}	28–32	2.0	2.7	2.3	3.0	3.8	58.2	28.0	8.6	Silty clay loam
S59Pa-39-9-6	B_{24}	32–41	1.2	2.2	2.4	2.8	3.8	60.4	27.2	6.7	Silty clay loam
S59Pa-39-9-7	B_{31}	41–46	1.6	1.9	2.3	3.3	4.0	58.8	28.1	9.0	Silty clay loam
S59Pa-39-9-8	B_{32}	46–53	1.7	2.2	3.1	4.6	5.4	56.2	26.8	13.2	Silt loam
S59Pa-39-9-9	C_1	53–58	4.6	5.2	4.9	5.2	6.1	58.2	15.8	56.5	Silt loam
Montevallo channery silt loam:											
S59Pa-39-1-1	A_p	0–7	10.6	7.1	3.4	3.9	6.9	62.8	5.3	52.9	Silt loam
S59Pa-39-1-2	B_3	7–11	14.2	8.6	3.9	3.5	5.7	45.3	18.8	69.9	Loam
S59Pa-39-1-3	C_1	11–16	31.5	20.1	6.8	2.8	2.1	24.2	12.5	84.1	Coarse sandy loam.
S59Pa-39-1-4	C_2	16–24	32.7	23.0	7.2	2.3	1.6	20.0	13.2	85.2	Coarse sandy loam.
S59Pa-39-6-1	A_p	0–9	15.9	10.9	6.2	5.0	3.1	40.6	18.3	57.9	Loam
S59Pa-39-6-2	B_1	9–12	15.6	13.0	8.0	6.0	3.3	36.6	17.5	69.5	Loam
S59Pa-39-6-3	B_3	12–16	14.0	12.8	9.9	7.6	4.5	34.3	16.9	65.6	Loam
S59Pa-39-6-4	C_1	16–24	10.2	10.4	9.6	10.3	5.7	37.0	16.8	52.4	Loam
Trexler shaly silt loam:											
S59Pa-39-3-1	A_p	0–10	6.4	5.4	4.7	4.9	3.8	52.8	22.0	31.7	Silt loam
S59Pa-39-3-2	B_1	10–16	8.9	5.5	4.3	4.4	3.8	48.8	24.3	32.2	Loam
S59Pa-39-3-3	B_{21}	16–22	7.9	6.0	5.2	5.8	4.6	48.7	21.8	31.1	Loam
S59Pa-39-3-4	B_{22}	22–29	9.4	6.8	7.3	7.2	5.4	46.0	17.9	40.0	Loam
S59Pa-39-3-5	II B_3	29–41	5.4	5.8	5.3	5.8	3.6	49.8	24.3	48.2	Loam
S59Pa-39-3-6	II C_1	41–50	8.5	7.7	6.4	5.9	4.5	42.2	24.8	46.4	Loam

analyses of selected soils

not taken or material not present]

Bulk density	Moisture held at—		Organic carbon	Nitrogen	Carbon-nitrogen ratio	Extractable cations (milliequivalents per 100 grams of soil)					Cation exchange capacity (sum)	Base saturation (sum)	Reaction (field)
	Tension of 1/3 atmosphere	Tension of 15 atmospheres				Calcium	Magnesium	Sodium	Potassium	Hydrogen			
Gm./cc.	*Percent*	*Percent*	*Percent*	*Percent*							*Meq./100 gms.*	*Percent*	*pH*
1.27	15.6	8.2	1.39	0.109	12.8	6.4	1.5	0.6	0.3	6.3	15.1	58.3	6.3
1.42	17.5	9.7	.46	.045	10.2	5.8	1.8	.1	.1	6.1	13.9	56.1	6.2
1.50	20.0	11.5	.29	.038	7.6	6.2	1.3	.1	.1	5.8	13.5	57.0	6.1
1.59	20.0	10.7	.22	.024	9.2	7.4	2.8	.1	.1	5.9	16.3	63.8	6.1
1.66	17.7	9.8	.13	----	----	5.0	3.3	.2	.1	5.6	14.2	60.6	6.2
1.57	21.1	9.6	.09	----	----	4.8	3.2	.2	.1	5.7	14.0	59.3	6.2
----	----	6.1	.16	----	----	3.4	2.5	.1	.1	5.0	11.1	54.9	6.2
1.26	18.0	8.8	1.23	.146	8.4	6.0	2.3	.2	.2	6.9	15.6	55.8	6.0
1.39	16.4	9.5	.61	.062	9.8	4.6	1.5	.1	.1	5.4	11.7	53.8	6.0
1.45	19.4	11.7	.36	.034	10.6	4.6	2.4	.1	.1	5.7	12.9	55.8	5.9
1.59	19.6	13.7	.24	.033	7.3	5.8	2.4	.1	.1	7.0	15.4	54.5	5.9
1.47	21.9	13.9	.08	.023	3.5	7.0	3.9	.1	.1	7.4	18.5	60.0	5.8
1.49	20.5	12.8	.36	.023	15.6	6.3	3.8	.2	.1	6.9	17.3	60.1	5.8
1.52	20.6	13.5	.17	----	----	7.2	4.2	.1	.1	7.3	18.9	61.4	5.8
----	----	10.8	.10	----	----	6.9	4.1	.1	.1	6.8	18.0	62.2	5.7
1.08	31.2	11.7	2.50	.250	10.0	16.9	.4	.1	.1	4.7	22.2	78.8	7.2
1.35	26.4	10.6	.48	.164	2.9	8.5	.5	.1	.1	2.8	12.0	76.7	7.4
1.34	24.6	12.8	.30	.160	1.9	9.6	.6	.1	.1	2.7	13.1	79.4	7.4
1.44	24.9	12.3	.28	.156	1.8	9.2	.3	.2	.1	3.2	13.0	75.4	7.4
1.28	24.6	12.0	.18	.150	1.2	9.1	.4	.2	.1	3.2	13.0	75.4	7.3
1.31	23.7	11.4	.21	.159	1.3	8.7	.6	.2	.1	5.1	14.7	65.3	7.2
1.57	23.1	11.0	.18	.168	1.1	5.0	1.2	.1	.1	9.0	15.4	41.6	5.8
1.42	23.6	9.1	.16	----	----	3.2	2.1	.1	.1	9.1	14.6	37.7	5.5
1.41	28.6	9.3	.14	----	----	2.5	2.5	.1	.1	8.7	13.9	37.4	5.3
----	----	11.6	.06	----	----	2.5	3.7	.1	.1	8.8	15.2	42.1	5.2
1.14	29.6	12.4	2.74	.282	9.7	7.7	.8	.1	.2	9.6	17.8	49.4	6.4
1.27	27.5	12.3	.52	.183	2.8	5.0	.5	.1	.1	7.1	12.8	44.5	6.4
1.32	27.8	12.6	.23	.159	1.5	5.9	.9	.1	.1	6.8	13.8	50.7	6.5
1.45	27.1	11.9	.20	.156	1.3	4.3	1.2	.1	.1	6.3	12.0	47.5	5.7
1.50	25.1	11.8	.17	.199	.8	3.2	.8	.1	<.1	6.8	10.9	37.6	5.4
1.38	26.3	11.7	.13	----	----	3.2	1.0	.1	<.1	7.4	11.7	36.7	5.4
1.55	24.7	12.0	.10	----	----	2.4	1.5	.1	<.1	6.1	10.1	39.6	5.5
1.53	24.6	10.8	.10	----	----	2.8	.9	.1	.<1	4.5	8.3	45.8	5.3
----	----	10.8	.08	----	----	2.7	1.3	<.1	.<1	3.5	7.5	53.3	5.2
1.18	----	8.6	2.16	.192	11.2	6.4	.5	.1	.8	6.6	14.4	54.2	5.9
----	----	10.1	1.78	.160	11.1	4.9	.4	.1	.1	7.0	12.5	44.0	6.1
----	----	10.5	.86	.097	8.9	3.3	.4	.1	.1	4.9	8.8	44.3	6.2
----	----	10.5	.52	.076	6.8	3.2	.3	.1	.1	4.1	7.8	47.4	6.0
1.26	----	10.0	2.27	.185	12.3	6.5	.5	.2	.1	7.8	15.1	48.3	5.6
----	----	8.3	.52	.075	6.9	3.7	.4	.1	.1	3.8	8.1	53.1	5.8
----	----	8.5	.35	.072	4.9	3.5	.4	.1	<.1	4.2	8.2	48.8	6.2
----	----	8.5	.24	.073	3.3	3.4	.5	.1	<.1	3.3	7.3	54.8	6.4
1.53	21.9	9.2	1.52	.139	10.9	3.9	.5	.1	.8	8.6	13.9	38.1	6.0
1.64	20.9	8.9	.42	.073	5.8	3.7	1.1	.1	.1	4.9	9.9	50.5	6.2
1.58	20.2	9.4	.35	.055	6.4	3.2	.7	.1	.1	5.1	9.2	44.6	6.2
1.58	21.1	10.8	.14	.055	2.5	2.3	.5	.1	<.1	6.7	9.6	30.2	5.3
----	----	9.4	.06	.052	1.2	3.4	.3	.1	<.1	8.2	12.0	31.7	5.0
----	----	8.7	.04	.055	----	3.7	.2	.2	<.1	8.8	12.9	31.8	5.0

TABLE 9.—*Mechanical and chemical*

[Dashes in columns indicate sample

Soil name and sample number	Horizon	Depth	Particle-size distribution							Coarse fragments (greater than 2 mm.)	Textural class
			Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.5 mm.)	Medium sand (0.5 to to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (less than 0.002 mm.)		
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percentage by weight*	
S59Pa-39-4-1	A_p	0-8	5.7	6.7	5.0	5.9	5.1	49.6	22.0	24.8	Silt loam
S59Pa-39-4-2	B_1	8-11	5.6	5.5	3.6	3.9	3.9	52.7	24.8	20.9	Silt loam
S59Pa-39-4-3	B_{21}	11-16	4.6	5.4	4.2	4.6	4.1	51.4	25.7	21.2	Silt loam
S59Pa-39-4-4	B_{22}	16-26	5.6	8.1	6.1	7.0	5.6	42.6	25.0	27.1	Loam
S59Pa-39-4-5	B_{23}	26-35	9.1	10.7	7.1	6.8	5.1	39.2	22.0	40.4	Loam
S59Pa-39-4-6	B_3	35-46	10.5	14.8	10.2	7.2	4.6	28.9	23.8	40.4	Loam
S59Pa-39-4-7	C_1	46-52	12.1	14.9	9.2	6.6	4.4	30.7	22.1	33.2	Loam
Trexler shaly loam, moderately shallow:											
S59Pa-39-2-1	A_p	0-11	20.3	10.6	4.7	2.8	1.5	38.1	22.0	49.3	Loam
S59Pa-39-2-2	B_{21}	11-19	25.4	11.6	5.3	3.0	1.6	32.3	20.8	63.8	Loam
S59Pa-39-2-3	B_{22}	19-25	13.2	10.8	7.4	5.4	3.2	40.5	19.5	70.6	Loam
S59Pa-39-2-4	C_1	25-36	7.6	8.7	7.5	7.4	5.5	50.0	13.3	72.6	Silt loam
S59Pa-39-7-1	A_p	0-10	11.4	6.9	4.3	3.9	2.6	47.9	23.0	42.9	Loam
S59Pa-39-7-2	B_{21}	10-17	15.4	10.3	5.8	4.3	2.7	42.7	18.8	49.5	Loam
S59Pa-39-7-3	B_{22}	17-21	18.2	12.9	6.7	5.1	2.4	37.3	17.4	66.5	Loam
S59Pa-39-7-4	B_3	21-26	20.3	15.2	8.8	5.2	2.5	31.8	16.2	69.3	Coarse sandy loam
S59Pa-39-7-5	C_1	26-33	16.5	16.1	11.5	7.2	3.6	29.1	16.0	71.8	Coarse sandy loam
Washington gravelly loam, coarse variant:											
S59Pa-39-5-1	A_p	0-8	10.9	9.6	4.4	3.4	2.6	45.1	24.0	60.3	Loam
S59Pa-39-5-2	B_1	8-15	10.5	9.4	4.5	3.5	2.9	50.2	19.0	51.1	Silt loam
S59Pa-39-5-3	B_{21}	15-22	10.0	9.4	6.3	5.0	3.4	38.9	27.0	53.4	Clay loam
S59Pa-39-5-4	B_{22}	22-26	9.9	13.3	10.8	5.9	3.3	22.4	34.4	66.4	Clay loam
S59Pa-39-5-5	B_{31}	26-36	9.6	10.4	6.3	4.5	3.3	26.0	39.9	57.9	Clay loam
S59Pa-39-5-6	B_{32}	36-45	5.2	10.0	9.0	7.6	4.2	22.3	41.7	73.8	Clay
S59Pa-39-5-7	C_1	45-50	7.2	17.6	17.8	13.1	5.8	18.7	19.8	32.2	Sandy loam
S59Pa-39-12-1	A_p	0-8	9.1	18.3	10.3	9.8	6.9	27.1	18.5	34.7	Coarse sandy loam
S59Pa-39-12-2	A_3	8-11	11.1	13.8	8.1	11.2	10.4	23.2	22.2	40.5	Sandy clay loam
S59Pa-39-12-3	B_{21}	11-17	13.9	20.4	9.2	7.9	7.0	16.9	24.7	57.3	Sandy clay loam
S59Pa-39-12-4	B_{22}	17-24	18.3	28.1	13.3	3.4	2.0	5.5	29.4	61.4	Sandy clay loam
S59Pa-39-12-5	B_{23}	24-31	12.2	28.6	20.1	3.6	1.8	5.9	27.8	65.7	Sandy clay loam
S59Pa-39-12-6	B_{31}	31-35	8.7	47.0	18.5	2.8	1.1	1.1	20.8	43.2	Sandy clay loam
S59Pa-39-12-7	B_{32}	35-44	4.4	46.4	31.0	2.1	.8	2.8	12.5	17.2	Loamy coarse sand
S59Pa-39-12-8	C_1	44-53	9.6	58.1	17.0	3.4	1.3	.7	9.9	23.4	Loamy coarse sand
S59Pa-39-12-9	C_2	53-58+	.5	2.3	3.9	38.0	28.2	20.6	6.5	7.0	Fine sandy loam
Washington silt loam:											
S59Pa-39-10-1	A_p	0-8	2.1	3.0	2.9	3.1	3.2	64.2	21.5	22.5	Silt loam
S59Pa-39-10-2	A_3	8-11	1.8	2.4	2.2	2.1	2.6	59.8	29.1	30.0	Silty clay loam
S59Pa-39-10-3	B_1	11-14	2.5	2.3	2.3	2.5	2.8	56.8	30.8	24.3	Silty clay loam
S59Pa-39-10-4	B_{21}	14-17	2.3	2.5	2.7	2.6	2.9	55.1	31.9	26.9	Silty clay loam
S59Pa-39-10-5	B_{22}	17-27	3.0	3.6	3.4	3.4	3.6	41.8	41.2	24.9	Silty clay
S59Pa-39-10-6	B_3	27-37	2.1	3.4	2.8	2.8	4.2	46.2	38.5	19.0	Silty clay loam.
S59Pa-39-10-7	C_1	37-46	1.9	1.7	1.6	2.4	5.5	51.2	35.7	8.4	Silty clay loam
S59Pa-39-10-8	C_2	46-67	2.2	2.2	1.8	2.4	5.8	54.0	31.6	15.0	Silty clay loam
S59Pa-39-11-1	A_p	0-9	2.0	2.5	3.6	3.4	4.5	66.3	17.7	9.1	Silt loam
S59Pa-39-11-2	A_3	9-12	1.8	2.1	2.7	3.0	4.6	57.1	28.7	8.6	Silty clay loam
S59Pa-39-11-3	B_1	12-16	1.5	2.3	2.8	2.8	5.0	54.5	31.1	13.8	Silty clay loam
S59Pa-39-11-4	B_{21}	16-21	2.2	2.3	2.7	2.9	5.2	48.7	36.0	17.7	Silty clay loam
S59Pa-39-11-5	B_{22}	21-29	2.5	2.7	3.3	3.5	5.7	49.5	32.8	12.8	Silty clay loam
S59Pa-39-11-6	B_{23}	29-33	2.4	3.2	3.3	3.5	6.2	47.7	33.7	11.2	Silty clay loam
S59Pa-39-11-7	B_{31}	33-40	2.0	2.4	3.1	3.3	6.1	45.9	37.2	14.2	Silty clay loam
S59Pa-39-11-8	B_{32}	40-43	2.1	2.7	2.9	3.4	5.6	46.3	37.0	22.2	Silty clay loam
	D_r	43+									

analyses of selected soils—Continued

not taken or material not present]

Bulk density	Moisture held at—		Organic carbon	Nitrogen	Carbon-nitrogen ratio	Extractable cations (milliequivalents per 100 grams of soil)					Cation exchange capacity (sum)	Base saturation (sum)	Reaction (field)
	Tension of 1/3 atmosphere	Tension of 15 atmospheres				Calcium	Magnesium	Sodium	Potassium	Hydrogen			
Gm./cc.	*Percent*	*Percent*	*Percent*	*Percent*							*Meq./100 gms.*	*Percent*	*pH*
1.45	---	10.5	1.08	.109	9.9	8.6	0.3	0.1	0.2	1.7	10.9	84.4	7.1
1.48	---	9.9	.18	.067	2.7	6.6	.2	.2	.1	2.0	9.1	78.0	7.4
---	---	9.8	.16	---	---	5.9	.1	.1	.1	2.1	8.3	74.7	7.4
---	---	10.3	.11	---	---	4.0	<.1	.1	<.1	5.4	9.5	43.2	6.6
---	---	10.6	.06	---	---	2.4	.2	<.1	<.1	5.2	7.8	33.3	6.4
---	---	10.8	.06	---	---	1.8	.2	<.1	.1	3.1	5.2	40.4	5.2
---	---	10.1	.06	---	---	1.9	.1	<.1	<.1	4.0	6.0	33.3	5.2
1.48	20.0	7.8	2.06	.191	10.8	6.9	1.1	.1	.3	7.8	16.2	51.9	5.8
1.50	18.8	8.1	.38	.088	4.3	4.4	1.0	.1	.1	4.6	10.2	54.9	6.2
---	---	8.9	.31	.079	3.9	4.3	.5	.1	.1	4.0	9.0	55.6	6.3
---	---	11.3	.17	.067	2.5	3.3	.7	.1	<.1	3.8	7.9	51.9	6.3
1.24	21.9	10.1	1.77	.139	12.7	6.7	.4	.1	.1	6.9	14.2	51.4	6.0
1.46	17.5	9.0	.33	.063	5.2	3.6	.4	.1	.1	4.0	8.2	51.2	6.4
---	---	9.4	.28	.060	4.7	3.7	.3	.1	.1	3.6	7.8	53.8	6.4
---	---	9.0	.21	.072	2.9	3.5	.3	.1	.1	3.6	7.6	52.6	6.5
---	---	8.5	.21	.069	3.0	3.4	.4	.1	.1	3.5	7.5	53.3	6.5
1.28	22.5	11.0	3.13	.240	13.0	12.1	.5	.2	.9	3.8	17.5	78.3	7.3
1.32	18.9	9.6	.60	.074	8.1	4.2	.3	.2	.5	3.0	8.2	63.4	7.2
---	---	10.2	.28	.062	4.5	3.9	.1	.1	.3	2.9	7.3	60.3	7.2
---	---	14.4	.21	.067	3.1	4.6	.2	.1	.2	3.3	8.4	60.7	7.2
---	---	16.4	.11	---	---	4.8	.2	.1	.1	3.7	8.9	58.4	7.2
---	---	18.0	.11	---	---	4.7	.3	.1	<.1	3.6	8.7	58.6	7.0
---	---	9.9	.06	---	---	2.4	.2	.1	<.1	2.7	5.4	50.0	6.8
---	---	8.1	1.79	.149	12.0	6.0	.6	.1	.2	2.8	9.7	71.1	7.0
---	---	9.2	.41	.070	5.9	5.1	.7	.1	.1	2.8	8.8	68.2	6.9
---	---	11.2	.32	.069	4.6	5.3	.8	.1	.1	3.1	9.4	67.0	7.2
---	---	15.4	.28	.068	4.1	6.3	.7	.2	.1	3.5	10.8	67.6	7.2
---	---	13.8	.16	---	---	6.3	.8	.2	<.1	4.0	11.3	64.6	7.1
---	---	8.7	.14	---	---	4.0	.8	.2	<.1	4.5	9.5	52.6	6.5
---	---	5.4	.10	---	---	3.5	.4	.2	<.1	4.5	8.6	47.7	7.0
---	---	6.9	.08	---	---	2.7	.6	.2	<.1	3.2	6.7	52.2	7.0
---	---	5.7	.07	---	---	2.7	.5	.1	<.1	2.6	5.9	55.9	7.2
1.40	14.6	10.2	1.20	.129	9.3	7.6	.7	.1	.1	5.7	14.2	59.9	6.4
1.43	17.6	12.3	.78	.054	14.4	5.9	.6	.1	.1	4.4	11.1	60.4	6.9
1.50	16.6	13.2	.30	.053	5.7	5.7	1.0	.1	<.1	4.4	11.2	60.7	6.9
1.56	16.3	14.2	.30	.046	6.5	5.6	1.3	.1	<.1	4.5	11.5	60.9	6.9
1.53	21.6	17.0	.18	.052	3.5	5.1	1.2	.1	<.1	4.3	10.7	59.8	6.9
1.54	21.6	15.7	.14	---	---	2.8	1.1	.1	<.1	5.0	9.0	44.4	6.8
1.54	23.3	14.8	.08	---	---	2.3	.9	.1	<.1	5.4	8.7	37.9	6.3
---	---	13.5	.10	---	---	2.2	.9	.1	<.1	6.3	9.5	33.7	6.4
1.23	23.1	9.2	1.57	.120	13.1	6.2	.6	.1	.2	6.6	13.7	51.8	6.3
1.30	21.4	11.7	.26	.042	6.2	4.2	.5	<.1	.1	5.1	9.9	48.5	6.5
1.50	20.9	13.2	.26	.032	8.1	4.2	1.0	<.1	.1	4.9	10.2	52.0	6.5
1.56	20.7	15.1	.24	.032	7.5	3.5	1.3	<.1	.1	5.4	10.3	47.6	6.5
1.64	18.8	15.6	.22	.032	6.9	3.3	1.8	<.1	.1	5.2	10.4	50.0	6.6
1.66	18.5	15.4	.13	---	---	2.1	1.8	<.1	.1	6.4	10.4	38.5	6.3
1.63	18.0	16.0	.12	---	---	1.0	1.8	<.1	.1	6.1	9.0	32.2	5.6
---	---	15.2	.09	---	---	.6	1.9	<.1	.1	6.5	9.1	28.6	5.4

The difference between moisture held at ⅓ atmosphere tension and at 15 atmospheres tension was not measured. The coarse texture of the soils and shallowness over shale indicate low available moisture capacity. These conditions make the soils droughty.

In sample S59Pa–39–1 base saturation is slightly lower in the deeper horizons than in the A_p horizon, but in the other profile it was about the same. The close range of the values suggests that the base saturation has been affected by the addition of liming materials. The profiles of the two Montevallo soils sampled are medium acid to slightly acid; the samples were taken in areas that were being farmed.

In these two profiles the cation exchange capacity in the lower horizons is low because of the small amount of clay there. These two soils are moderate to low in their ability to hold nutrients for plants to use. Organic carbon is high in the A_p horizon, but the content in the horizons below is markedly lower. The high organic carbon in the A_p horizon is the result of plowing under crop residues, which also causes the A_p horizon to have a higher exchange capacity than the deeper horizons.

Trexler Shaly Silt Loam

The horizons in these two moderately deep to deep profiles of Trexler soils are medium textured. The amount of coarse fragments is moderate and is generally greatest in the deepest horizons. In most places there is more silt than sand, and the content of sand is generally greatest in the deepest horizons.

The presence of a weakly expressed B horizon is shown by the content of clay at a depth between 10 and 41 inches in one profile and at a depth of 8 to 46 inches in the other. Because of the weakly expressed textural B horizon, the soil belongs to the Sols Bruns Acides great soil group, but it has some properties of soils in the Gray-Brown Podzolic great soil group. The smaller amount of clay in the horizons below a depth of about 24 inches suggests the beginning of a C horizon. Nonconforming parent material is indicated by the large amount of clay in the B_3 and C_1 horizons.

The difference between moisture held at ⅓ atmosphere tension and at 15 atmospheres tension ranges from 10 to 13 percent. It is slightly larger than that in the profiles of Trexler shaly silt loam, moderately shallow, and it is also larger than that in the profiles of the Montevallo soil. Because the solum of the Trexler shaly silt loams is thicker than that of the moderately shallow Trexler shaly silt loam and the Montevallo soil, it can hold a larger amount of moisture for plants to use than the solum of those soils.

Base saturation ranges from about 30 to 84 percent in the two profiles and is generally less in the deepest horizons. This pattern is typical of soils that are strongly weathered. The high base saturation is the result of having applied lime to the soils to maintain a pH desirable for alfalfa and other legumes.

Reaction in the two profiles ranges from neutral to strongly acid. The pH tends to follow base saturation and is most acid in the deepest horizons. In sample S59Pa–39–4 the pH is somewhat higher than in the other profile because of recent liming.

The cation exchange capacity ranges from 5.2 to 13.9; it is generally higher in the upper part of the profile because there is more organic matter there. In profile S59Pa–39–3 the exchange capacity is higher in the lower two horizons because of the larger amount of clay.

The amount of organic carbon is closely related to the content of organic matter in the profile. Below the A_p horizon, the content of carbon is markedly less. It indicates an artificially high content of organic matter for these soils, which is the result of mixing crop residues and manure into the plow layer. The amount of carbon in the lower horizon is less because few roots penetrate the deeper layers.

Trexler Shaly Loam, Moderately Shallow

The horizons in the two profiles of moderately shallow Trexler shaly loams are medium textured, but in one profile the texture, at a depth below 21 inches, is moderately coarse. The content of sand ranges from 29 to 55 percent. It is greatest in the deepest horizons of sample S59Pa–39–7, but it is slightly less in the other profile after reaching about 45 percent in the B_{21} horizon. The number of coarse fragments is greatest in the deepest horizons. The subsoil is generally loamy.

The difference between the amount of moisture held at ⅓ atmosphere tension and at 15 atmospheres tension is greater than in the Montevallo soils, and it extends to a greater depth. Thus, these soils are able to hold more moisture for plants to use than the Montevallo soils. They have moderate available moisture capacity. These soils are less droughty than the Montevallo soils, but they are more droughty than the deep Trexler soils.

Base saturation is about the same throughout the profile, or increases slightly in the deepest horizons. Although this increase suggests the properties of a Gray-Brown Podzolic soil, the weakly expressed B horizon indicates that these soils are members of the Sols Bruns Acides great soil group.

The profile of these two Trexler soils is medium acid to slightly acid. The pH follows the pattern of base saturation; the profile is slightly less acid in the deepest horizon.

The cation exchange capacity shows a sharp decline from the A_p to the B_{21} horizon, and then a more gradual decline. The abrupt change is the result of large amounts of organic matter having been mixed into the A_p horizon. These soils lack the ability to hold large amounts of nutrients for plants to use.

Organic carbon is highest in the plow layer because of the high content of organic matter. Because organic matter has a high exchange capacity and the amount of organic matter is less in the horizons below the plow layer, the exchange capacity is also lower.

Washington Gravelly Loam, Coarse Variant

The horizons in the two profiles of Washington gravelly loam, coarse variant, are medium textured to moderately fine textured, except that in one profile the material is coarse textured at a depth between 35 and 53 inches. The content of sand ranges from 30 to 89 percent. The content of gravel ranges from 7 to 74 percent, and the gravel is distributed in varying amounts throughout the profile. The distribution of sand and gravel suggests weak stratification. The content of silt generally becomes less with increasing depth, but in profile S59Pa–39–12 the amount of silt is markedly greater in the C_2 horizon.

The presence of a textural B horizon is shown by the content of clay between a depth of 15 and 45 inches in one profile and between a depth of 11 and 35 inches in the other profile. The C horizon consists of weakly stratified sand and gravel that has coatings of clay and silt.

The profiles of these two Washington soils show that base saturation decreases with increasing depth, probably because of the use of liming materials. In the profiles the pH follows the general pattern of base saturation.

The cation exchange capacity for these profiles ranges from 5 to 17 and is generally lower in the deepest horizon. The high value in the A_p layer is apparently associated with the high content of organic matter in that layer. The cation exchange capacity is generally lower than that of the Washington silt loams and indicates that the Washington gravelly loams are lower in ability to hold plant nutrients.

Organic carbon in these two profiles is high in the A_p horizon because the content of organic matter has been increased by plowing under crop residues.

The amount of organic carbon in the profile is generally smallest in the deepest horizon.

Washington Silt Loam

The horizons in the two profiles of Washington silt loam are medium to moderately fine textured. The content of sand ranges from 11 to 19 percent, and the sand occurs without forming a pattern in the profile. Coarse fragments are concentrated in the surface layer in some places and are lacking in others. In one of the profiles, the amount of coarse fragments is slightly greater in the deepest horizon, and in the other the amount is slightly smaller.

A textural B horizon is shown by the content of clay in the B horizons between a depth of 11 and 37 inches in one profile and between a depth of 12 and 43 inches in the other. The Washington soils have the best expressed textural B horizon of any of the soils analyzed in this county. In places the lower boundary of the solum rests on bedrock, and in other places it rests on glacial till.

The difference between moisture held at 1/3 atmosphere tension and 15 atmospheres tension ranges from 2 to 14 percent. The solum is deep enough to hold a moderate to large amount of moisture. The soil can, therefore, store enough moisture to carry a crop through a normal dry spell.

Base saturation ranges from about 29 to 61 percent and tends to decrease with increasing depth. Reaction in the first profile of these two Washington silt loams ranges from neutral to strongly acid, and in the second profile, from neutral to slightly acid. The pH tends to follow the general pattern of base saturation.

The cation exchange capacity ranges from 14.2 to 8.7 but decreases with increasing depth. The value in the A_p horizon is considerably higher than in the other horizons because organic matter was added when crops were plowed under. Organic carbon is high in the A_p horizon, but the amount in the horizons below that layer is markedly less.

General Nature of the County

This section provides general information about the physiography, geology, water supply, climate, settlement, and population of the county. It also gives facts about the agriculture.

Physiography

Lehigh County is in the Appalachian Highlands physiographic division. The area is divided into three provinces. These are underlain by geologic formations that weather to form a characteristic landscape with a closely related pattern of soils. The provinces are further divided into sections—the Appalachian Valley section of the Ridge and Valley Province, the Reading Prong of the New England Upland, and the Triassic Lowland of the Piedmont Province (*4*, *10*).

Appalachian Valley Section

The northern three-fourths of the county is in the Appalachian Valley section. This section extends from the lower slopes of South Mountain to the county line on Blue Mountain. Its southern part consists of the Allentown Valley, which is underlain by a fairly broad belt of Cambrian and Ordovician limestone. The floor of this valley is generally nearly level to undulating, but in a few places there are broad, low stream divides where there are small streams. The sides of the valleys of these streams have gentle slopes.

The average elevation of the stream divides is about 400 feet, but a few hills rise to an elevation that is 20 to 60 feet higher. Also, some sinks are 20 or more feet lower. The lack of a distinct stream pattern and the presence of the many sinkholes indicate that there is an extensive underground drainage system in the underlying cavernous limestone.

The terminal moraines in the area indicate that the limestone topography has been influenced by Illinoian glaciation. The terminal moraines are somewhat higher than the surrounding areas. They contain more closed depressions and wet spots than other areas underlain by limestone. The soils on the moraines are also more gravelly or stony than those in surrounding areas. Back of the terminal moraines are fewer pebbles and cobbles. Also, in some places there is evidence of frost churning or mixing of the soil material. In the areas of terminal moraines, the prominent features generally associated with glaciation are absent or greatly subdued.

The soils in the area underlain by limestone are commonly deep, well drained, and productive. Because water drains rapidly through most of them and there are many cracks, caverns, and sinkholes in the underlying limestone, few of the areas are wet. In a few places, however, the depressions hold enough water after a heavy rain to drown out plants that do not tolerate a large amount of moisture. The soil material in the depressions is medium textured and holds moisture. As a result, the soils cannot be worked so early in spring as some of the other soils.

Also in the Appalachian Valley section, but north of the Allentown Valley, is an area underlain by Martinsburg shale of Ordovician age. In some places in the northern part of this area, the shale has been metamorphosed to slate. The area extends to the foot of Kittatinny, or Blue, Mountain. It is characterized by well-dissected uplands, steep-sided valleys, and numerous streams. The soils in the area are moderately sloping to steep; the stream divides are well rounded, and a few of them have broad, nearly level tops. In the southern part of this area, these nearly level hilltops are generally at an elevation of from 650 to 700 feet. In some areas there is

hard sandstone where the crests of the hills rise to more than 900 feet.

The streams in the area underlain by shale have cut valleys to a depth of 100 to 400 feet. The major streams are Jordan and Coplay Creeks, which flow into the Lehigh River, and Mill and Ontelaunee Creeks, which flow westward into the Schuylkill River.

Evidences of glaciation are even less conspicuous in the area underlain by shale than in the valley underlain by limestone. There are many erratic quartzite cobbles and boulders, and the shale and soil materials have been frost churned. The scattered pockets of unusually deep soils suggest that the soil materials accumulated or were deposited by means other than those commonly associated with soils that developed in place. Some of the soils in the pockets have a conspicuous red color.

The soils in the area underlain by shale are considerably more varied than those that are underlain by limestone. The bedrock underlying them is less permeable, and the area is drained by numerous streams. Most of these soils are moderately deep and well drained. They have moderate to low moisture-holding capacity and are generally moderately productive. The soils on the flood plains and along the heads of streams, however, are wet. Those on the steep side slopes of the valleys and hills are subject to erosion, and, as a result, they are shallow over the parent material.

The broad, smooth, gently sloping divides and ridgetops in the northern part of the area have a cover of soils that are deep and well drained. At the base of long or steep slopes, in the areas underlain by shale, there are commonly seeplines where water emerges at the surface. The soils on the adjacent lower slopes or benches receive seepage water and are poorly drained.

The extreme northern part of the Appalachian Valley section is occupied by Blue Mountain. This even-crested mountain ridge ranges in elevation from 1,400 to 1,600 feet and is the most impressive topographic feature of the region. Blue Mountain is formed by Tuscarora conglomerate, sandstone, and quartzite. These rocks are hard and are more resistant to erosion than the softer shales and limestones. The place where the Tuscarora and Martinsburg formations meet is about halfway up the slope of the mountain, but it is covered by talus and colluvial material. The sides of the mountain are strongly sloping or very steep, and the areas at the foot of the slopes are strongly sloping or rolling.

The mountainous landscape is characterized by stony and ledgy areas and by boulder fields that are on the steepest slopes. The top and middle parts of the slopes are covered by soils that are shallow to moderately deep over material weathered from quartzite or sandstone. The soils on the lower slopes developed in colluvial material that accumulated as the result of frost action and mudflow.

The soils in the montainous area have a well-developed structure and a red or reddish-yellow, fine-textured subsoil. Most of them are well drained, but some of the nearly level soils are stony and are moderately well drained or poorly drained. Generally, in areas that have not been cleared, the soils of this area are very stony. They have moderate moisture-holding capacity and are moderately productive.

Reading Prong

The Reading Prong in Lehigh County is represented by South Mountain and by the area underlain by Precambrian crystalline rocks. The crystalline rocks are granite and gneiss of the Byram and Pochuck formations and metadiabase and other minor igneous and metamorphic rocks. The region is a dissected upland of irregular hills and ridges that extend in a northeast-southwest direction and are separated by narrow valleys. The tops of the hills are mostly 500 to 1,000 feet above sea level, but the top of the ridge near Macungie is more than 1,080 feet above sea level. In some places the ridges are underlain by quartzite. The lower slopes of the mountain are covered by colluvium or glacial till to a depth of 50 or more feet. The area is drained by Perkiomen Creek, which empties into the Schuylkill River.

In this area the gently sloping to very strongly sloping soils are stony and are deep and well drained. The steep or very steep soils are shallow over bedrock. In the divides and along streams or valley floors where there are seeplines, there is a small acreage of wet soils. The soils that have been used for agriculture have generally been cleared of stones and boulders. Most of the soils in this area are easy to work. They hold moisture well and are highly productive.

Triassic Lowland

The Triassic Lowland of Lehigh County consists of rounded hills underlain by red sandstone, shale, and conglomerate of Triassic age. In places diabase (traprock or ironstone) has intruded into these formations. The Triassic Lowland of Lehigh County is not typical of the Triassic Lowland in southeastern Pennsylvania, which is undulating or rolling and is underlain by shale. In Lehigh County the area shows little evidence of glaciation.

The soils of the Triassic Lowland are moderately deep to deep over sandstone, conglomerate, or diabase. In the areas underlain by shale, the soils are moderately deep to shallow over shale. There are many, small, wet spots and areas of moderately well drained soils in the drainageways. The soils of the Triassic Lowland are moderate to low in moisture-holding capacity and are moderately productive. In some places they are difficult to work because of the wet spots.

Geology

Geology has had a direct and marked effect on the soils of Lehigh County, and in places glaciation has influenced the soil material. The effects of glaciation and the bedrock of the county are discussed in the following pages.

Glaciation

The Illinoian glaciers covered the northeast and central parts of Lehigh County, but only minor evidence of Wisconsin glaciation can be seen in the county. The Wisconsin glaciers extended slightly south of Delaware Gap and into Northampton County. The existence of glaciation in the area earlier than the Illinoian is questionable (*9*).

Most of the area underlain by limestone and shale was covered by the Illinoian ice sheet. The area extends westward from the Northampton County line along the foot of South Mountain into Lehigh County and westward to Emmaus. At Emmaus the boundary of the area turns

northwest toward Wescosville and Schnecksville and then northward to Pleasant Corners and New Tripoli. At New Tripoli it turns northeast, follows the foot of Blue Mountain, and then extends eastward into Northampton County.

Most of the till transported by the glacier was from areas nearby, and, therefore, little evidence of glaciation remains. The erratics, which consist of fragments of sandstone and quartzite, were derived mainly from Blue Mountain. The layer of till was generally too thin, 0 to 30 feet thick, to conceal the basins that had developed in the limestone valley. The presence of the till is indicated only by patches of deep, reddish-brown or red Trexler soils in areas underlain by shale and by the pebbles, cobbles, and boulders in the Washington soils in areas underlain by limestone.

The effects of glaciation are the most conspicuous in the terminal moraine that extends from Emmaus to East Texas, Wescosville, Chapman, Siegersville, and Schnecksville. The moraine is about one-half mile wide and is 20 to 40 feet high (*9*). The topography of the moraine has a subdued sag and swell and has more depressions and small hills than are in the somewhat smoother, adjacent areas. The depressions in the moraine hold water for a long period. Thus, the area has more wet spots and more poorly drained soils than other areas. The soils also contain large amounts of gravel and cobbles that came from areas outside of the valley of the Lehigh River. An example of soils in this area are the Washington gravelly loams near Siegersville. In the area underlain by shale, there are a few erratics and some evidence of frost-churned shale in several places.

The large areas of soils developed on colluvial material at the foot of Blue Mountain and South Mountain suggest that the climate was once a severe periglacial one. There has been much frost action, and there are many mudflows and boulder slides that in places moved out one-half mile or more from the mountains. The soils developed in these materials show that the materials had been in place a very long time or that they were highly weathered before they were transported to their present location. Examples of these soils are the Laidig, Buchanan, and Andover.

Bedrock

Lehigh County is underlain by beds of sedimentary, igneous, and metamorphic rocks that have many folds. Folding, faulting, and erosion have exposed the rock formations in many places. The formations range in age from approximately the oldest known on the American continent to the youngest (*10*). The rocks are of the Precambrian, Cambrian, Ordovician, and Triassic ages. The major geologic formations of the county are shown in table 10. Their characteristics are discussed in the paragraphs that follow.

The oldest formations in the county are the Precambrian rocks, which occupy an irregular belt about 5 miles wide across the southeastern part of the county. The area includes South Mountain and other upland areas and ridges in the southern part of the county. The formations are the Franklin, Moravian Heights, Pochuck gneiss, and Byram gneiss. These formations consist of crystalline rocks that have undergone mineralogical and structural changes and were then recrystallized by dynamic metamorphism.

The oldest formation of the Precambrian group is the Franklin formation, which consists of limestone and quartz-graphite schist. In Lehigh County only a small acreage is underlain by this formation. One of the few rock outcrops of the formation is a steep knob approximately 1 mile north of Hosensack. The Moravian Heights formation of the Precambrian group is of about the same age as the Franklin formation. It underlies only two small, isolated areas south of Bethlehem. The Moravian Heights formation consists of streaks and bands of sericitic to serpentinelike material surrounded by mosaic quartz or by quartz and feldspar.

Pochuck gneiss and Byram granite gneiss are the main Precambrian formations. The Pochuck formation is made up of approximately equal amounts of light-colored feldspar and dark-colored hornblende. Generally, a stone of this formation has a dark salt-and-pepper appearance. The Byram formation consists mainly of feldspar and quartz; it is pinkish or nearly white.

The rocks of Cambrian age are the next oldest group in the county. The formations in this group are the Hardyston, the Tomstown, and the Allentown. The Hardyston formation outcrops in narrow bands on the steep slopes of South Mountain and on the crests of hills scattered throughout the southern part of the county. The Hardyston formation consists of quartzite, arkosic sandstone, and conglomerate. The soils in the areas underlain by the Hardyston formation are fairly sandy and gravelly. The Tomstown and Allentown formations consist of limestone that contains a large amount of calcium and magnesium carbonate. In most places these formations lie parallel to South Mountain in the central part of the county and extend in a northeasterly to southwesterly direction. Other areas are in Saucon Valley in the southeastern part of the county.

The Beekmantown, Jacksonburg, and Martinsburg formations are of Ordovician age, although the Beekmantown formation is similar to the Tomstown and Allentown formations of Cambrian age. The soils weathered from the Tomstown, Allentown, and Beekmantown formations have been disturbed by glacial action. They are in the same catena.

The Jacksonburg formation is composed mainly of argillaceous limestone, but it consists generally of dark-gray to black, fine-textured rocks that are transitional from limestone to shale. Cement is manufactured from limestone of the Jacksonburg formation. In Lehigh County the soils formed in material weathered from the Jacksonburg formation are more silty than the other soils weathered from limestone.

The Martinsburg formation lies between Blue Mountain and the areas underlain by limestone. It consists mainly of brown to gray shale, and of dark-blue slate, but it is brown sandstone in the northwestern part of the county. Small amounts of red and green shale also occur in the formation. Some high ridges in the Martinsburg area contain grayish-brown, fine-grained sandstone. An example is Shochary Ridge in the northwestern part of the county. In many places shale outcrops on the rounded hills that slope steeply to deep, narrow valleys. The beds of the formation are highly folded and faulted and lie at many angles.

TABLE 10.—*Major geologic formations of Lehigh County* [1]

Geologic system	Geologic formation or bedrock	Description of rocks
Triassic	Diabase	Chiefly, medium-grained to coarse-grained, gray plagioclase feldspar and black or green augite.
	Brunswick	Red to brown, fine-grained to coarse-grained quartzitic sandstone and quartz pebble conglomerate with red shale interbeds; interbedded shale and limestone conglomerate.
Silurian	Shawangunk	Light-gray to tan, thick-bedded, impure quartzitic sandstone and conglomerate with thin shale interbeds.
Ordovician	Martinsburg	Gray to dark-gray shale that weathers to light gray or olive and has thick sandstone interbeds; contains interbedded red shale, gray to brown sandstone, and thin-bedded limestone.
	Jacksonburg	Dark-gray to black, thin-bedded, argillaceous limestone and medium gray to dark-gray plates of medium-textured, crystalline limestone; carbonaceous at base.
	Beekmantown	Light-gray to dark-gray, very fine to medium, crystalline dolomite and bluish-gray to dark-gray, fine, crystalline limestone that contains irregular beds, stringers, and nodules of chert, sand, and conglmoerate.
Cambrian	Allentown	Gray limestone with siliceous and argillaceous bands and laminae and dark-gray to light-gray dolomite; sandy in lower part; cryptozoon reefs.
	Tomstown	Massive dolomite; thin, shaly interbeds.
	Hardyston	Quartzite with conglomerate at base.
Precambrian	Byram granite gneiss	Dark-gray, moderately coarse grained granite to finer grained, light-gray, pink, or nearly white granite.
	Pochuck gneiss	Dark-colored hornblende gneiss that contains pyroxene, mica, feldspar, and quartz.
	Moravian Heights	Light-colored granitic material; streaks and patches of sillimanite and sericite.
	Franklin	Massive granulose to poorly schistose quartz-graphite schist; includes white limestone or marble that contains graphite.

[1] Adapted from Geologic Map of Pennsylvania unless otherwise noted.

Only one formation of Triassic age—the Brunswick—is in this county. It underlies the rounded hills in the southeastern part of the county. The soils that developed in material weathered from rocks of the Brunswick formation are reddish and are fine textured. Deposits of red shale, siltstone, sandstone, and conglomerate make up the formation. After they were deposited, masses of lava were forced toward the surface through fissures in the earth, and in places they formed the rock known as diabase. This intrusive material formed long, narrow dikes and occurs in the southern part of the county, just south of Hosensack. The diabase rock is hard and tough, and it has a black, white, or gray color. Locally, this rock is called ironstone.

Water Supply

Most of the farms in the northern and southern parts of the county are crossed by streams. Many of the streams originate from seeps and springs on the lower slopes of narrow valleys. In many places springs furnish enough water to supply farmhouses and barns with running water. The pastures are generally located along small brooks or creeks.

In the more level or undulating valleys underlain by limestone, there are fewer springs and streams than in the northern and southern parts of the county. Small brooks flow into sinks in many places and disappear into subterranean channels. The water for the farms in many places comes from drilled wells or cisterns. There are large springs, however, in the areas underlain by limestone. The city of Allentown obtains most of its supply of water from two large springs from which the flow is 12 million gallons of water daily. Other communities also use springs as a source of water. Water for industry and irrigation comes from streams and wells, but many of the smaller streams are not dependable sources of water because they often dry up.

In general, fairly large quantities of soft water are obtained at a depth of 25 to 500 feet in areas underlain by Triassic sandstone and shale. Small to moderate amounts of water are obtained in areas underlain by Martinsburg shale, and the water in many of these areas is hard. The areas underlain by cement rock supply a fairly small amount of water. The areas underlain by limestone generally do not supply a dependable amount of water. In places large amounts of water have been obtained from wells drilled into limestone formations, but in many places only dry holes resulted from drilling. The areas underlain by crystalline rock supply a small amount of soft water (*6*).

Climate

Lehigh County is in a humid, temperate region. It has a modified continental type of climate. The average annual rainfall is about 43 inches. It is generally dependable and is distributed fairly evenly throughout the year.

Table 11, compiled from records of the United States Weather Bureau at the Allentown Gas Company, gives

TABLE 11.—*Temperature and precipitation at Allentown Gas Company, Lehigh County, Pennsylvania*

[Elevation, 245 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1941)	Wettest year (1952)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
January	29. 5	76	−7	3. 39	3. 24	4. 79	6. 5
February	29. 6	73	−12	2. 80	1. 58	1. 82	8. 1
March	38. 5	85	−5	3. 40	2. 50	5. 01	4. 3
April	48. 9	85	20	3. 48	1. 84	8. 49	. 4
May	60. 7	95	30	3. 95	1. 40	4. 42	[3]
June	69. 7	102	39	3. 89	2. 51	1. 51	0
July	74. 1	103	46	4. 77	4. 01	7. 26	[3]
August	72. 0	100	41	4. 53	3. 11	6. 45	[3]
September	65. 0	97	31	3. 47	. 40	6. 16	0
October	53. 8	93	21	3. 11	2. 12	1. 17	[3]
November	42. 9	82	3	3. 00	2. 71	5. 44	1. 5
December	32. 1	70	−4	3. 23	3. 34	4. 68	5. 4
Year	51. 4	103	−12	43. 02	28. 76	57. 20	26. 2

[1] Average temperature based on a 34-year record, through 1955; highest and lowest temperatures based on a 22-year record, through 1952.

[2] Average precipitation based on a 44-year record, through 1955; wettest and driest years based on a 44-year record, in the period 1912–1955; snowfall based on an 18-year record, through 1952.

[3] Trace.

normal average monthly and annual temperatures and precipitation typical for the county. The Allentown Gas Company has the most complete weather records in the county, but partial records are available from Weather Bureau stations at Claussville, New Tripoli, and Zionsville. The temperature at these outlying stations is slightly higher than that at Allentown, and the precipitation is heavier. At Claussville, the average annual rainfall is about 52 inches. At New Tripoli it is about 48 inches, and at Zionsville, about 49 inches.

In the central part of the county, the average length of the growing season is 170 days, but the growing season is slightly shorter in the northern part. The average date of the last killing frost in spring is about April 25 in the central part of the county and about April 30 in the northern part. In fall, the average date of the first killing frost is October 15 in the central part of the county and about October 10 in the northern part.

The temperature falls to 32° F. or lower no oftener than 100 days a year. Below-zero temperatures occur in only about one winter in three. The average depth that frost penetrates is 13 inches, and the fields are covered with snow for about one-third of the winter.

Temperatures of 100° or higher are fairly rare. In summer, the temperature rises to 90° or higher on only about 15 days. Uncomfortably warm periods that last from 4 to 7 days occur occasionally in summer when light winds and the high humidity make the weather oppressive. Periods of drought that last long enough to damage crops occur about once in 10 years.

Settlement and Population [5]

Lehigh County received its name from the Lehigh River, which is the largest stream in the county. The earliest known inhabitants were the Delaware Indians, who obtained their food by hunting, fishing, and growing corn, squash, and beans.

The first pioneer settlement was probably made in 1715 when German immigrants located in the township of Lower Milford. Most of the German settlers came by the way of the Oley Valley and the Perkiomen Creek. Later, Swiss, English, and Welsh immigrants came from Philadelphia to settle in the Lower Saucon Valley. The only organized group of immigrants were Moravians who came to serve as missionaries to the Indians. They founded the city of Bethlehem in 1741.

The area was officially opened to settlement in 1734, and the first road was laid out the next year in Upper Macungie Township. The first township was Upper Milford, which was organized in 1737. In 1762, the county seat of Northhampton was laid out, but later the name was changed to Allentown. Lehigh County was separated from Northampton County in 1812.

In 1752, the population of the area that is now Lehigh County was 2,900, and, by 1773, there were 900 farmers in that area. The population continued to grow, and in 1960, according to the U.S. Bureau of the Census, there were 227,536 persons living in the county.

Community Facilities and Industries

The large cities and small, established communities in Lehigh County are well equipped with stores, shopping centers, churches, secondary schools, hospitals, libraries, and police and fire departments. Consolidated high schools have been established throughout the county. Muhlenberg College and Cedar Crest College are located in Allentown.

The development of industry in the last 50 years has provided employment for many people. Steel, cement, and textile industries have all been important to the economy of the county.

Transportation and Markets

This county has access to many types of transportation. Turnpikes, four-lane highways, and many other primary roads cross the county in all directions. U.S. Route No. 22 passes through Lehigh County from Harrisburg to New York. U.S. Route No. 309 provides a direct route to Philadelphia in the southern part of the State and to Pottsville and other major cities in the coal region in the northern part. U.S. Route No. 222 provides a direct route to Reading and Lancaster. Most of the roads in the county are of concrete or macadam.

The Reading Railway System has several lines that provide transportation in the county. Direct passenger service and freight service to New York and Philadelphia are provided by the Lehigh Valley Railroad and the Central

[5] The historical facts in this section were taken mainly from "Pennsylvania Agriculture and Country Life" (*5*).

Railroad Company of New Jersey. Several buslines provide transportation between major cities and principal towns, but most persons use privately owned vehicles.

Travel by airline is also readily available in this county. Both passenger service and freight service are available from the Allentown-Bethlehem-Easton Airport. Recently, the airport extended its runways to facilitate the use of jet airliners.

All farms in the county have access to main roads that lead to markets. The many highways and railways that pass through the county also provide access to large markets and help to make Lehigh County highly industrialized.

Agriculture

Agriculture has always been a leading occupation in Lehigh County. The early farmers grew only crops for their own needs. Then, when they had cleared enough land to provide more than they could use, they sold their surplus grain and livestock to settlers in the towns. Wheat was one of the earliest cash crops. Later, corn gained in importance and farms became more diversified.

Many farmers in the county now operate specialized farms and grow potatoes, fruit, or truck crops. The main crops, however, are corn, wheat, and hay, which are fed to livestock on the farms and are marketed in the form of meat or as dairy or poultry products.

Many of the early farmers rotated their crops and thus made use of hay and manure to help maintain the fertility of their soils. When the farmers began to sell more of their produce, they started to add lime and fertilizer to their soils and to improve the varieties of seed. The early farms were small, but, as farm machinery and farming techniques improved, the size of the farms increased. Now, most farms in the county are commercial farms.

As farming became more complex and technical, various programs were developed to help promote good farming practices. Consequently, in 1946, the county established the Lehigh County Soil Conservation District to help coordinate the work and advance the conservation of the soil and water resources of the county. The District has made cooperative agreements with the Pennsylvania State University, the Soil Conservation Service of the U.S. Department of Agriculture, the Pennsylvania Game Commission, the Pennsylvania Department of Forests and Waters, the Pennsylvania Fish Commission, the Pennsylvania Department of Highways, and the Pennsylvania Department of Agriculture. The Agricultural Extension Association, the Farm Credit Administration, the Farmers Home Administration, vocational agricultural departments, and other State and Federal agencies also serve the farmers of the county.

In the following paragraphs the types and sizes of farms in Lehigh County are discussed and the crops, pastures, livestock, and livestock products are described. The statistics used are from reports of the U.S. Census of Agriculture.

Farms of the county

In 1959, 60 percent of the total acreage in Lehigh County was in farms and the farms averaged 99.9 acres in size. There were 1,335 farms in the county. Of these, 526 were listed as miscellaneous or unclassified. The rest are classified by type as follows:

Dairy farms	150
Poultry farms	111
Livestock farms other than dairy or poultry	65
General farms	133
Field-crop farms other than fruit and nut	328
Fruit-and-nut farms	17
Vegetable farms	5

Land use.—As new roads are built and the cities spread out into adjacent farmlands, the number of farms will probably decrease and the acreage in farms is likely to become smaller. The remaining farms will probably be larger.

Of the 133,330 acres of land in farms in 1959, about 64.5 percent, or 86,046 acres, was cropland. Cleared pastures occupied about 4 percent, or 5,442 acres. In addition, 4,706 acres of cropland and 576 acres of woodland were pastured. Woods occupied 9.2 percent, or 12,324 acres. Grasses and legumes, grown to improve the soils, were planted on 5.2 percent of the acreage, or on 6,956 acres. Idle land accounted for 7,481 acres, and 9,799 acres was in roads, building sites, wasteland, and other land.

Tenure.—Most of the farmers in this county own the farms they operate. According to the 1959 census, full owners operated 836 farms, or 62.6 percent of the farms. Part owners operated 294 farms, and tenants operated 189. The tenants were mainly cash or share tenants.

Farm power and mechanical equipment.—Nearly all of the farms have electricity and telephone service. Most of the farm homes have modern laundry facilities. The farms are well equipped with tractors, trucks, milking machines, grain combines, pickup hay balers, and other mechanical equipment.

Crops

The acreage of the principal crops grown in 1959 is as follows:

	Acres
Corn for all purposes	25,117
Harvested for grain	24,287
Cut for silage	806
Hogged, grazed, or cut for silage	24
Wheat, threshed or combined	13,016
Oats, threshed or combined	11,353
Barley, threshed or combined	3,703
Rye, threshed or combined	661
Alfalfa and alfalfa mixtures cut for hay	15,026
Clover, timothy, and mixtures of clover and grasses cut for hay	6,027

In 1959, potatoes were grown on 5,682 acres on 387 farms. A total of 558,242 bushels of apples was harvested on 163 farms, and a total of 134,693 bushels of peaches was harvested on 89 farms.

Livestock

The raising of livestock was the main farming enterprise in the county in 1959. In that year the kinds and numbers of livestock raised were as follows:

	Number
Cattle and calves	[1] 10,821
Horses and mules	573
Hogs and pigs	9,270
Sheep and lambs	1,588
Chicken, 4 months old and more	354,263
Turkeys raised	103,360

[1] Includes 4,737 milk cows.

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Glossary

Alluvial soil. Soil formed in material, such as gravel, sand, silt or clay, deposited by a stream of water and showing little or no modification of the original material by soil-forming processes.

Available moisture capacity. The ability of a soil to hold water that will not drain away but that can be taken up by plant roots.

Base saturation. The relative degree to which a soil has absorbed metallic cations (calcium, potassium, magnesium, and so on). The proportion of the cation exchange capacity that is saturated with metallic cations.

Calcareous. Containing calcium carbonate or lime.

Catena, soil. A sequence of soils developed from one kind of parent material but differing in characteristics because of differences in drainage or relief.

Cement rock (local term). Clayey or shaly limestone, valuable as cement material; also called hydraulic limestone.

Channery soil. A soil that contains fragments of thin, flat sandstone, limestone, schist, or shale as much as 6 inches in length along the longer axis.

Clay. See Texture, soil.

Clay film. A coating of oriented clay particles commonly found on the surfaces of peds and in pores. The orientation of the clay is parallel to the ped surfaces, and in thin sections it has an abrupt boundary with the unoriented matrix. Under a hand lens the clay film has a very smooth, wavy appearance.

Claypan. A compact horizon or layer rich in clay and separated more or less abruptly from the overlying horizon.

Cobbles. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Colluvial soil. Soil formed from material that has been moved downhill by gravity, soil creep, frost action, or local erosion. It accumulates on the lower parts of slopes and at the bases of slopes.

Conglomerate. Rock composed of gravel and rounded stones cemented together by hardened clay, lime, iron oxide, or silica.

Consistence. The feel of the soil and the ease with which a lump can be crushed between the fingers. Terms commonly used to describe consistence follow:

Loose. Noncoherent; will not hold together in a mass.

Friable. When moist, crushes easily under moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctively noticeable.

Plastic. When wet, readily deformed by moderate pressure, but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material.

Hard. When dry, moderately resistant to pressure; can barely be broken between thumb and forefinger.

Cemented. Hard and brittle; little affected by moistening.

Diabase. A basic, igneous rock, locally called ironstone. It is composed essentially of plagioclase feldspar and augite with small quantities of magnetite and apatite.

Dike (rock). Igneous rock that was forced into a vertical crack or fissure while molten, then hardened in that shape.

Dolomite. A rock consisting chiefly of calcium carbonate and magnesium carbonate in approximately equal proportions.

Eluviation. The removal of material from a soil horizon by downward or lateral movement in solution, and, to a lesser extent, in colloidal suspension.

Gabbro. A more or less dark-colored, granular, igneous rock comprised mainly of plagioclase, generally labradorite, with a ferromagnesian mineral (augite, hypersthene, or hornblende) and accessory iron ore.

Gneiss. A crystalline rock in which the component minerals are arranged in parallel bands or layers. This rock tends to break into slabs.

Gully. Steep-sided channel resulting from accelerated erosion; large enough to be an obstacle to farm machinery.

Horizon, soil. A layer of soil, approximately parallel to the land surface, with distinct characteristics produced by soil-forming processes. Horizons are identified by letters and numbers.

A horizon. The horizon at the surface. It contains organic matter, has been leached of soluble minerals and clay, or shows the effects of both. The major A horizon may be subdivided into A_1, the part that is darkest in color because it contains organic matter, and A_2, the part that is the most leached and light-colored layer in the profile. In woodlands a layer of organic matter is called the A_0 horizon. The depth of soil, however, is measured from the top of the mineral soil because the A_0 horizon is easily destroyed by fire or by plowing if the soil is cultivated. Where the upper layers of the soil are thoroughly mixed by cultivation, this plow layer is called the A_p horizon.

B horizon. The horizon in which clay minerals or other material has accumulated, or that has developed a characteristic blocky or prismatic structure, or that shows the characteristics of both processes. It may be subdivided into B_1, B_2, or B_3, horizons. The B_2 horizon may be subdivided further by adding a number to the symbol, such as B_{21}, B_{22}, or B_{23}.

C horizon. The unconsolidated material immediately under the true soil. It is presumed to be similar in chemical, physical, and mineral composition to the material from which at least part of the overlying solum has developed.

D horizon. The material beneath the parent material. It may be unlike the parent material of the soil. If it consists of solid rock like that from which the parent material has developed, it is designated as the D_r horizon.

Gleyed horizon. A strongly mottled or gray horizon that occurs in wet soils. It is designated by the letters BG, CG, or sometimes merely G. A horizon only slightly gleyed may have the smaller letter g added to the symbol.

Igneous rock. A rock formed through the cooling of molten mineral materials; examples are granite, diabase, and gabbro.

Illuvial horizon. A horizon that has received material in solution or suspension from some other part of the soil.

Immature soil. A soil that lacks a well-developed profile or sequence of horizons.

Infiltration. The downward entry of water into the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering a high liquid limit indicates that the soil has a high content of clay and a low capacity for carrying loads.

Metamorphic rock. A rock that has been considerably altered by the combined action of pressure, heat, and water. Generally, the resulting rock is more compact and more highly crystalline than the original. Gneiss, schist, and marble are common examples.

Moraine. An accumulation of soil and rock materials having initial constructional topography that is independent of the surface underneath, built within a glaciated region chiefly by the direct action of glacier ice. A *terminal moraine* is a ridgelike accumulation of material along the downstream or terminal margin of a glacier.

Mottling, soil. Contrasting color patches that vary in number and size. Descriptive terms used are as follows: Contrast—*faint, distinct,* and *prominent;* abundance—*few, common,* and *many;* and size—*fine, medium,* and *coarse.* The size measurements are the following: Fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a *clod,* which is a mass of soil material molded by digging or other disturbance.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range in moisture content over which the soil remains plastic.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Quartzite. A compact, granular metamorphosed sandstone.

Reaction, soil. The degree of acidity or alkalinity of the soil, expressed in pH values or in words, as follows:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6–7.3
Very strongly acid	4.5–5.0	Mildly alkaline	7.4–7.8
Strongly acid	5.1–5.5	Moderately alkaline	7.9–8.4
Medium acid	5.6–6.0	Strongly alkaline	8.5–9.0
Slightly acid	6.1–6.5	Very strongly alkaline	9.1 and higher.

Rill. A steep-sided channel resulting from accelerated erosion but in most places only a few inches deep and wide; not large enough to be an obstacle to farm machinery.

Sand. See Texture, soil.

Sedimentary rock. A rock formed from an accumulation of sediment in water. Although there are many intermediate types, the principal groups of sedimentary rocks are (1) conglomerate (from gravel), (2) sandstone (from sand), (3) shale (from clay and silt) and (4) limestone (from deposits of calcium carbonate).

Series, soil. A group of soils that have similar characteristics, arrangement, and sequences of horizons in their soil profiles and that are derived from similar parent material. A series may consist of two or more soil types that differ from one another in the texture of the surface soil.

Shale. A sedimentary rock formed by the hardening of thin-bedded clay or silt deposits.

Sheet erosion. The removal of a fairly uniform layer of soil material from the surface of the land by the action of rainfall and runoff water without the formation of rills or gullies.

Silt. See Texture, soil.

Solum. The upper part of the soil profile above the parent material, in which the processes of soil formation have been active. The solum in mature soils consists of the A and B horizons.

Structure, soil. The arrangement of the primary soil particles into lumps, granules, or other aggregates. Structure is described by grade—as *weak, moderate,* or *strong,* that is the distinctness and durability of the aggregates. It is also described by the size of the aggregates—*very fine, fine, medium, coarse,* or *very coarse;* and by their shape—*platy, prismatic, columnar, blocky, granular,* or *crumb.* A soil is described as structureless if there are no observable aggregates. Structureless soils may be massive (coherent) or single grain (noncoherent).

Blocky, angular. The aggregates are shaped like blocks; they may have flat or round surfaces that join at sharp angles.

Blocky, subangular. The aggregates have some rounded and some flat surfaces; the upper sides are rounded.

Columnar. The aggregates are prismatic and are rounded at the top.

Crumb. The aggregates are generally soft, small, porous, and irregular, but tend toward a spherical shape.

Granular. Roughly spherical, firm, small aggregates that may be either hard or soft but that are generally more firm and less porous than crumb and without the distinct faces of blocky structure.

Platy. The aggregates are flaky or platelike.

Prismatic. The aggregates have flat, vertical surfaces, and their height is greater than their width.

Subsoil. The soil layers below the plow layer; the B horizon.

Substratum. The soil material below the surface soil and the subsoil; the C or D horizon.

Surface soil. The plow layer; the A horizon.

Texture, soil. The relative amounts of particles of different size classes, called sand, silt, and clay, determine texture. The common soil textures in Lehigh County are sandy loam, loam, and silt loam. Sandy loam is ½ to more than ⅘ sand and less than ⅕ clay—the remainder is silt. Loam is ¼ or less clay, ¼ to ½ sand, and ¼ to ½ silt. Silt loam is ½ or more silt, and as much as ½ sand, and the rest clay.

Clay. Small mineral soil grains, less than 0.002 millimeter (0.000079 inch) in diameter.

Silt. Small mineral soil grains ranging in size from 0.05 millimeter (0.002 inch) to 0.002 millimeter (0.000079 inch) in diameter.

Sand. Small rock or mineral fragments ranging from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.079 inch) in diameter.

Till. Those deposits laid down directly by the ice of a glacier. A less specific term than moraine.

Topsoil (in landscaping gardening or engineering). Soil material containing organic matter and suitable as a surfacing for filled or graded areas, such as shoulders and slopes.

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